# CMPT 733

# ~~Big Data Programming II~~

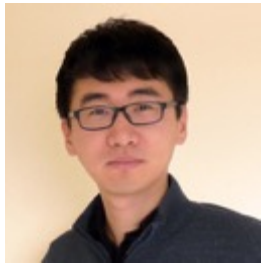
# Data Science

SLIDES BY:

JIANNAN WANG

https://sfu-db.github.io/bigdata-cmpt733/

# Who Are We?



Jiannan Wang

Associate Professor from SFU

Postdoc from UC Berkeley AMPLab

Ph.D. from Tsinghua University

10+ years of research experience in the **database** field

Steven Bergner

University Research Associate from SFU

Quantitative Analyst at FINCAD

Ph.D. and Postdoc from SFU

10+ years of research and working experience in the **visualization** field

# PMP Remote Teaching Survey

**32 Responses**

| Questions | Yes |
|---|---|
| Are you satisfied with **remote learning?** | 84% |
| Are you satisfied with **curriculum**? | 97% |
| Are you satisfied with **lab courses**? | 94% |
| Are you satisfied with **co-op office support?** | 100% |
| Are you satisfied with **academic team support**? | 84% |
| Do you **feel a sense of community** in your cohort? | 31% |
| Are you happy with your decision to **pursue the program**? | 88% |

1. Synchronous Teaching
2. Switch on Your Webcams
3. Add In-Class Discussion
4. Add In-Person Lab Sessions
5. Add Group Assignments

Provide anonymous feedback to improve courses
http://tiny.cc/733-feedback (Available from Jan - May 2021)

# Outline

What is Data Science?

Data Science Lifecycle

4 Questions Data Scientists Can Answer

The "Data Science" term: buzzword?

Course Structure

# What Is Data Science?

# Computer Science vs. Data Science

| What | When | Who | Goal |
|---|---|---|---|
| Computer Science | 1950- | Software Engineer | Write software to make computers work |

**Plan → Design → Develop → Test → Deploy → Maintain**

| What | When | Who | Goal |
|---|---|---|---|
| Data Science | 2010- | Data Scientist | Extract insights from data to answer questions |

**Collect→ Clean → Integrate → Analyze → Visualize → Communicate**

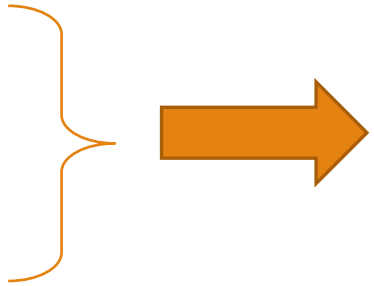
# New Skillset

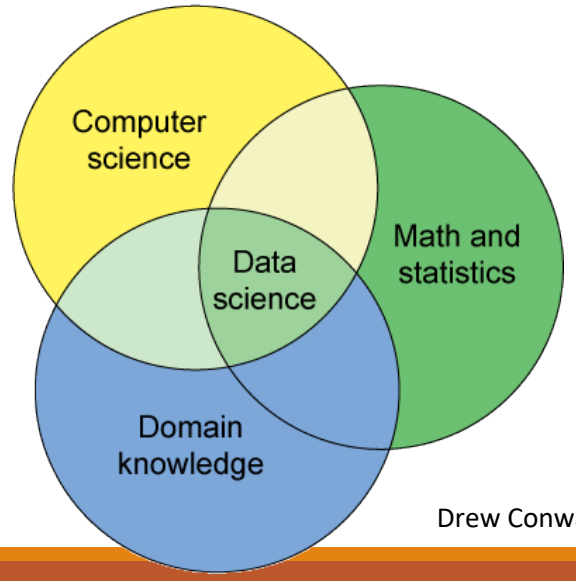
## Example Questions

- How popular will this new product be? (Predictive Model)
- Which features should be added? (A/B Testing)
- Who are the potential customers? (Recommendation System)
- ...

## What skills are needed to answer these questions?

- Programming Skills
- Machine Learning/Statistics
- Domain Knowledge

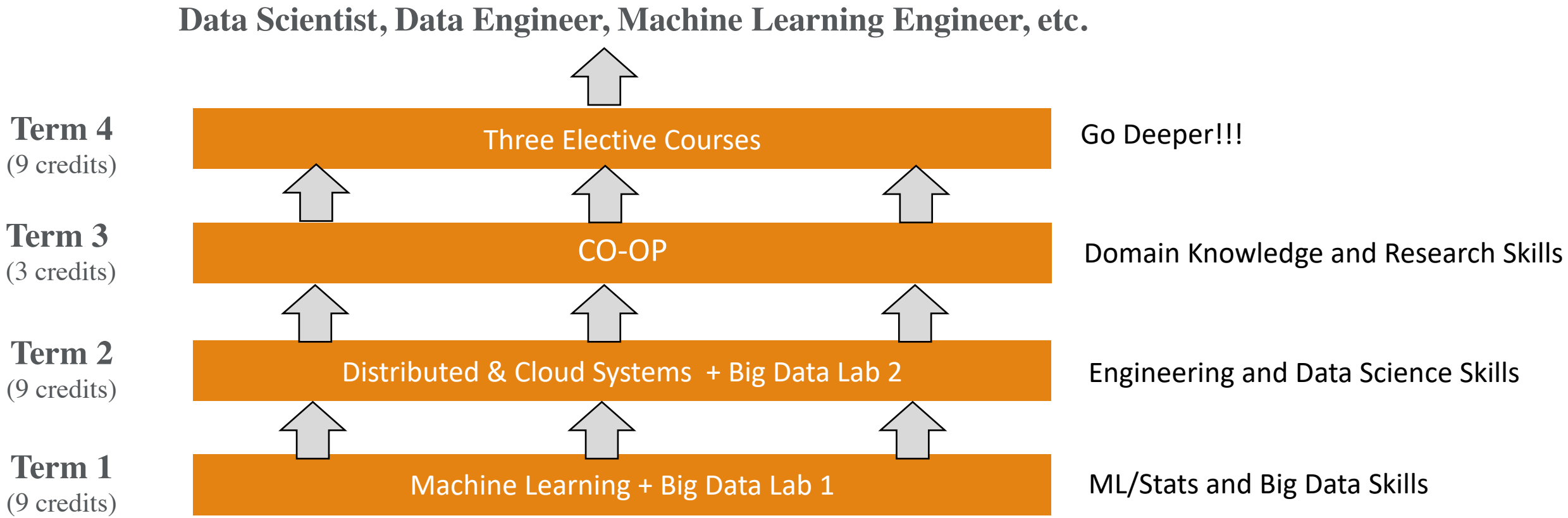





+ Research Skill

Drew Conway's Venn Diagram of Data Science

# SFU PMP Big Data Curriculum



# Data Science Lifecycle

# Data Science Lifecycle (High-Level)

The entire workflow is iterative

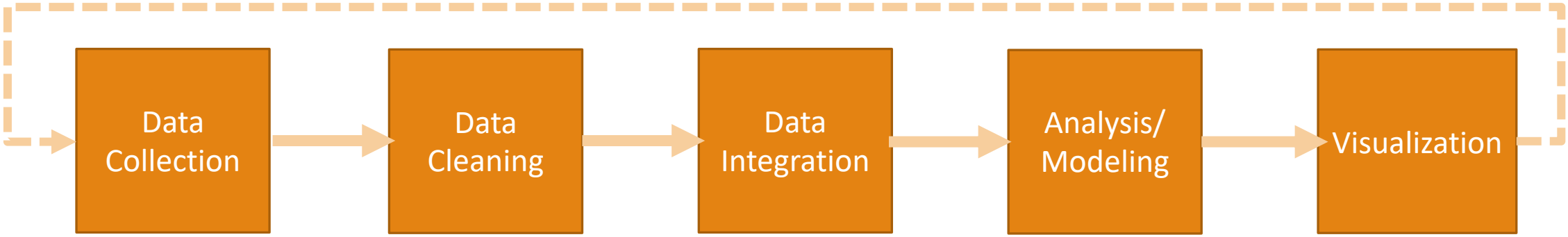

Two ways to produce questions

- Start with questions and then collect the related data
- Start with data and then think about the questions that can be answered

# Data Processing Pipeline

## What you think you do?


## What you really do?



At Least

# 4 Questions Data Scientists Can Answer

https://docs.microsoft.com/en-us/azure/machine-learning/studio/data-science-for-beginners-the-5-questions-data-science-answers

# Is This A or B?

## Classification Algorithms

## Examples

- Is this an image of a cat or a dog?
- Will this customer renew their subscription?
- Will this tire fail in the next thousand miles?

1. Which company do you work at?
2. Why does your company care about this question?
3. What data do you need to answer this question?
4. How do you evaluate how good your solution is?
5. What data product do you plan to build?

# Is This Weird?

## Anomaly Detection Algorithms

## Examples

- Is this transaction a fraud?
- Is this combination of purchases very different from what this customer has made in the past?
- Are these voltages normal for this season and time of day?

1. Which company do you work at?
2. Why does your company care about this question?
3. What data do you need to answer this question?
4. How do you evaluate how good your solution is?
5. What data product do you plan to build?

# How much or How Many?

## Regression Algorithms

## Examples

- How many new followers will I get next week?
- What will the temperature be next Tuesday?
- What will my fourth quarter sales in Canada be?

1. Which company do you work at?
2. Why does your company care about this question?
3. What data do you need to answer this question?
4. How do you evaluate how good your solution is?
5. What data product do you plan to build?

# How Is This Organized?

## Clustering Algorithms

## Examples

- Which shoppers have similar tastes in products?
- Which viewers like the same kind of movies?
- Which printer models fail the same way?

1. Which company do you work at?
2. Why does your company care about this question?
3. What data do you need to answer this question?
4. How do you evaluate how good your solution is?
5. What data product do you plan to build?

# The “Data Science” term: buzzword?

# What is a Buzzword?

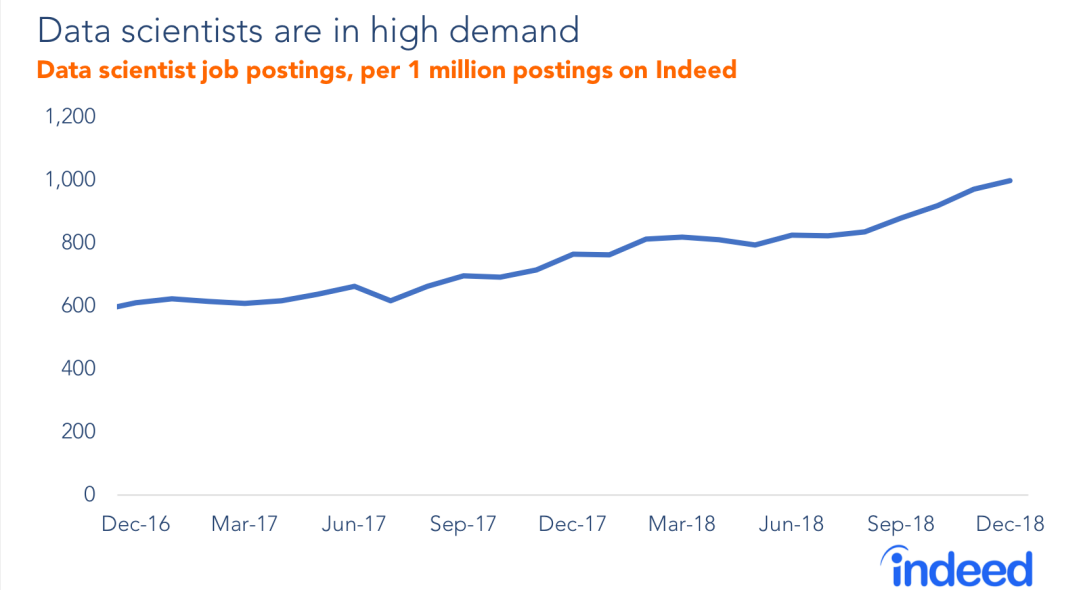
No clear definition

No big breakthrough on the technical side

No respect for the people who have been working on this kind of stuff for years

**Data Science was a Buzzword (before 2018)**

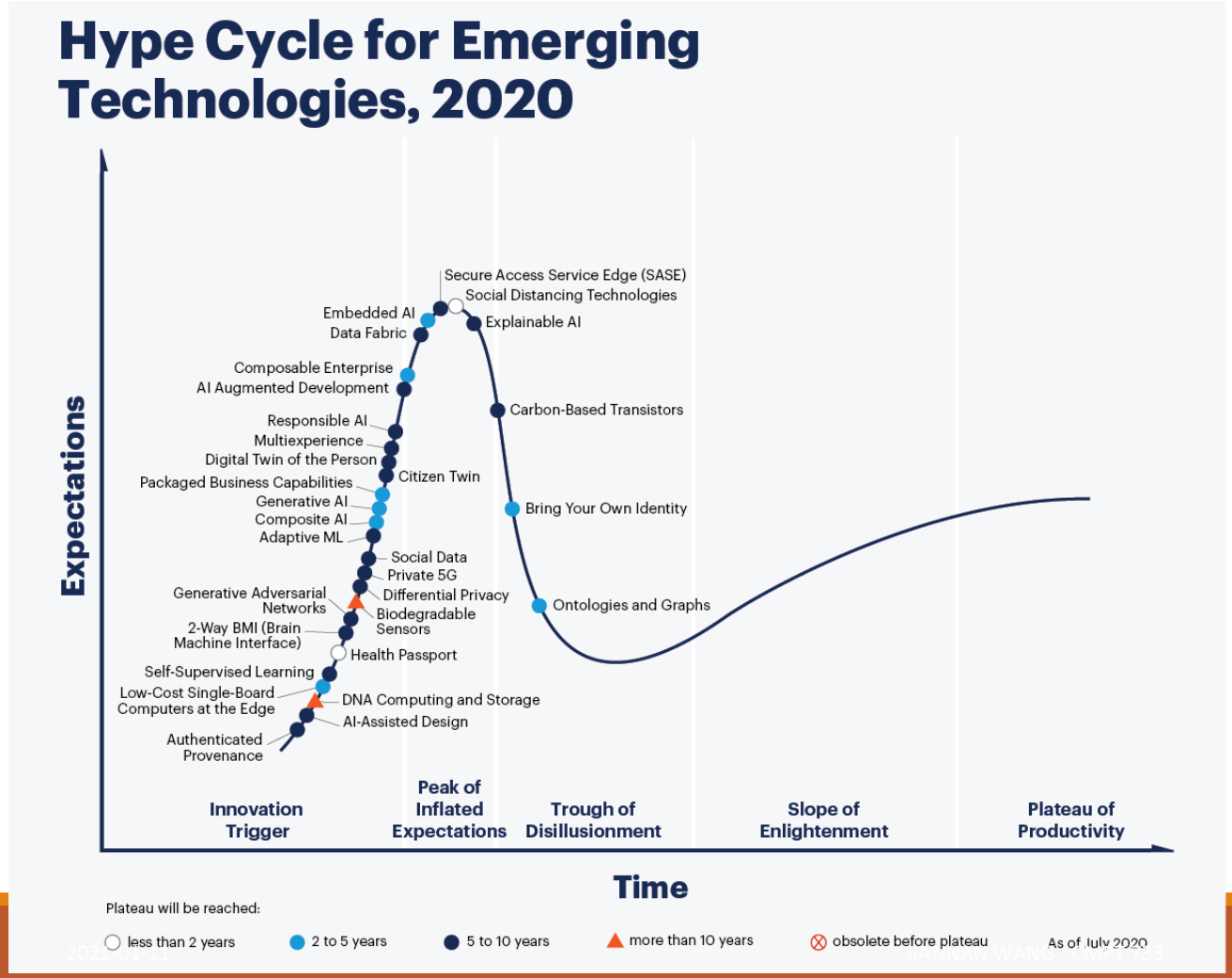
# Is Data Science Only a Buzzword?

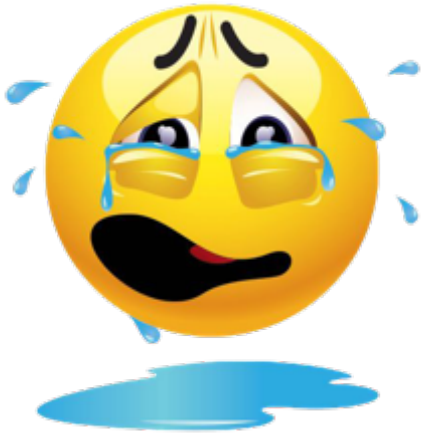



## What's New?

- The combination of the three skills
- Lots of data about many aspects of our lives
- Infinite computing power (due to cloud computing)
- The need for data science is not only in the tech giant, but everywhere

# Is Data Science Over-Hyped? Not Any More



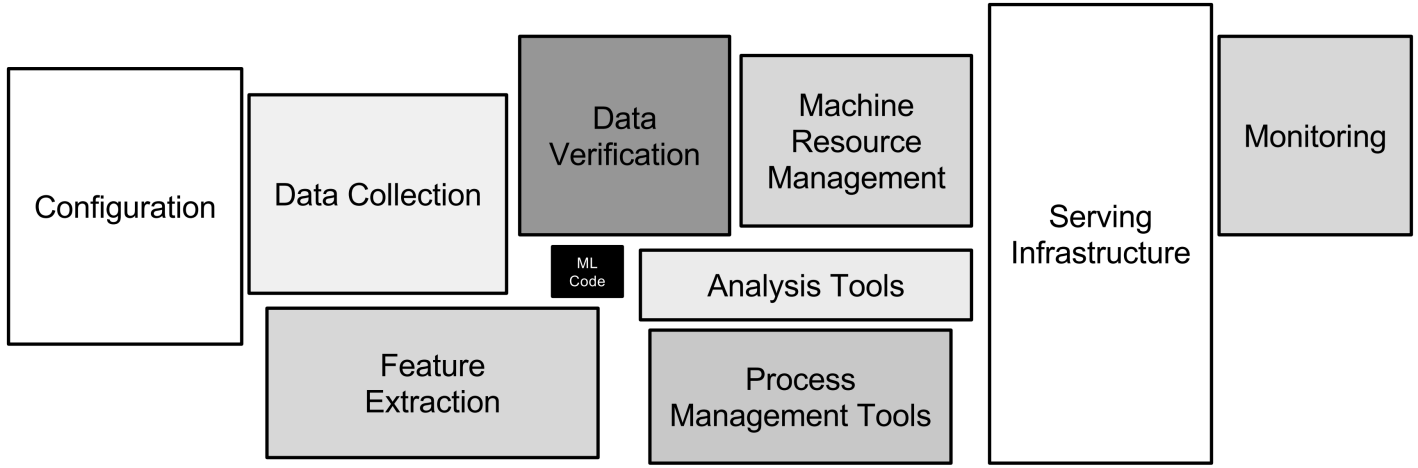
Where is "Data Science"?!
Where is "Big Data"?

# AI is the new hype, but…

Google
NeurIPS 2015

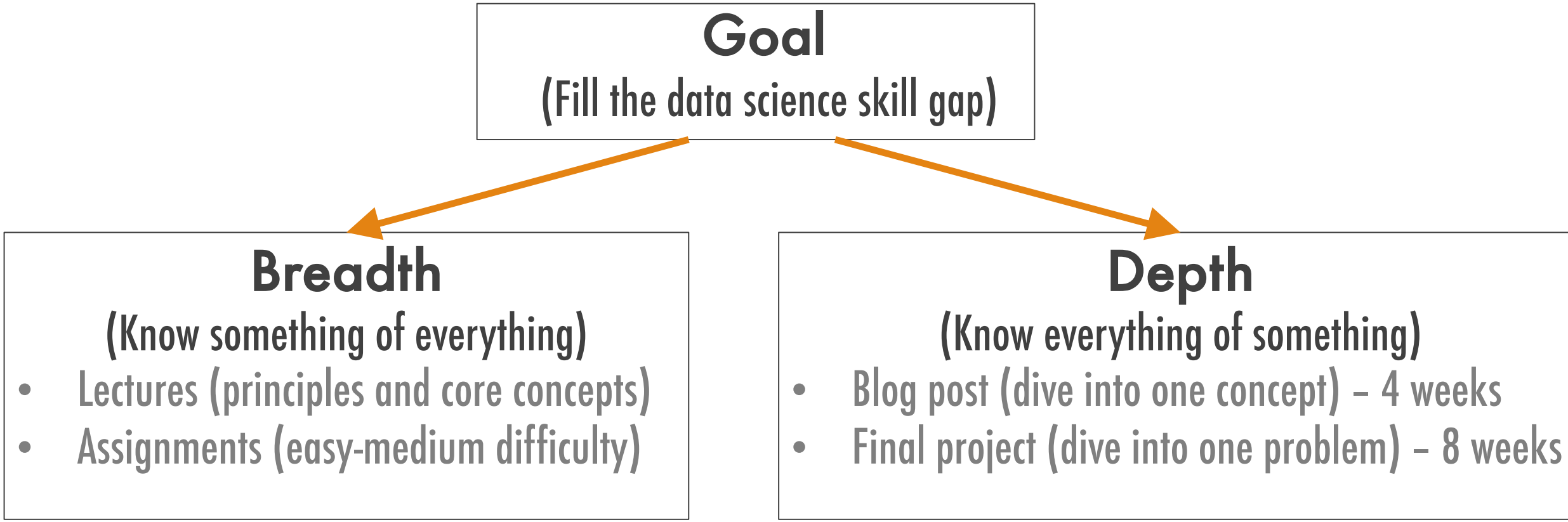
**Hidden Technical Debt in Machine Learning Systems**

**D. Sculley, Gary Holt, Daniel Golovin, Eugene Davydov, Todd Phillips**
{dsculley,gholt,dgg,edavydov,toddphillips}@google.com
Google, Inc.



# Course Structure

# What's This Course About?



# SFU Big Data Science Publication

([https://medium.com/sfu-big-data](https://medium.com/sfu-big-data)) **1300+** Followers; **100,000** visits in 3 months;


**Demystifying Random Forest**

A deep dive into Random Forest

Tushar Chand Kapoor

Mar 2, 2019 · 7 min read ★

Demystifying Random Forest

Distributed by curators in MACHINE LEARNING

**Lifetime summary**

Published on March 2, 2019 in SFU Big Data Science

| VIEWS | EARNINGS | AVERAGE READING TIME |
|---|---|---|
| 14.6K | $14.83 | 1 min 1 sec |

**Tushar Chand Kapoor**

Data Engineer at Best Buy CHQ | Machine Learning | Big Data | Azure | tusharck.com

NOV 12, 2019

**Tushar Chand Kapoor** • 10:21 pm

Hi Professor,

Thanks for introducing us to the world of writing articles on medium. This has really helped me along the way.

Regards

**Jiannan Wang** • 10:50 pm

I am so glad to hear this. You have the special talent of writing articles on medium. :)

**Tushar Chand Kapoor** • 11:06 pm

Thanks you very much :).

towards data science

**Glimpse into PyTorch3D: An open-source 3D deep learning library**

Tushar Chand Kapoor Feb 9, 2020 · 2 min read ★

**Object Detector Android App Using PyTorch Mobile Neural Network**

Tushar Chand Kapoor Nov 18, 2019 · 4 min read ★

# Final Project

## Proposal Phase (1wk)

## Milestone (3wks)

- Student presentation

## Final Project Presentation (4wks)

- Best Project Awards (10,000 CAD)
- Get feedback from **PMP Big Data Advisors**

**Beier Cai**

Co-Founder
*Commit*

**Jesse Calderon**

SVP, Product Development
*Tableau*

**George Chow**

Data Engineer
*Self-employed*

**Dennis Loktionov**

Director of Digital
*Teck Resources*

**Aly Sidi**

Vice President, Software
*Neurio Technologies*

**Ken Wong**

Senior Director of Product Management
*Tableau*

**Kate Wright**

VP, Product & Development
*SAP*

# Course Topics

1. Introduction to Data Science (1 weeks)
2. Data Preparation (1 week)
3. Visualization (2 weeks)
4. Statistics (2 weeks)
5. Practical Machine Learning (2 weeks)
6. Deep Learning (1.5 weeks)
7. Cloud Computing (0.5 week)
8. Responsible Data Science (1 week)

# Data Preparation

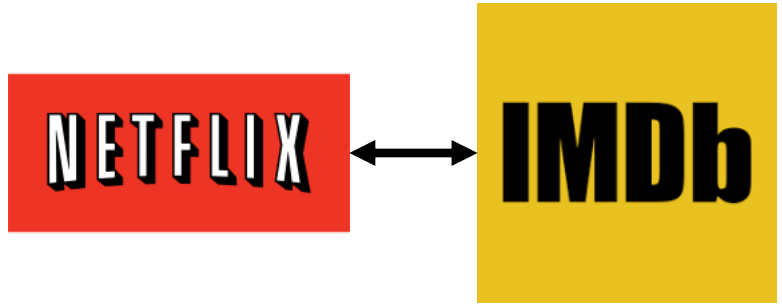
## Do you know data integration?

BRUCE SCHNEIER SECURITY 12.12.07 09:00 PM

### Why 'Anonymous' Data Sometimes Isn't

**LAST YEAR, NETFLIX** published 10 million movie rankings by 500,000 customers, as part of a challenge for people to come up with better recommendation systems than the one the company was using. The data was anonymized by removing personal details and replacing names with random numbers, to protect the privacy of the recommenders.

Arvind Narayanan and Vitaly Shmatikov, researchers at the University of Texas at Austin, de-anonymized some ofthe Netflix data by comparing rankings and timestamps with public information in the Internet Movie Database, or IMDb.

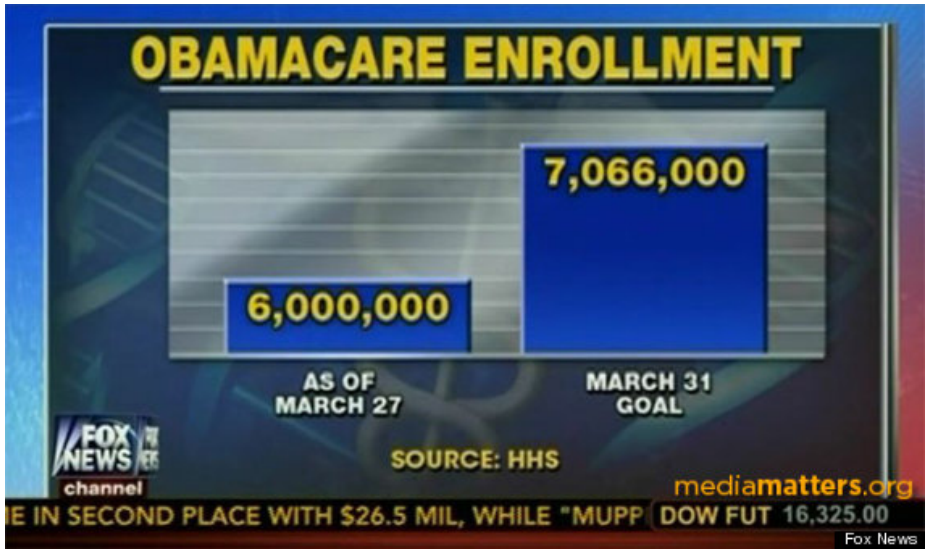


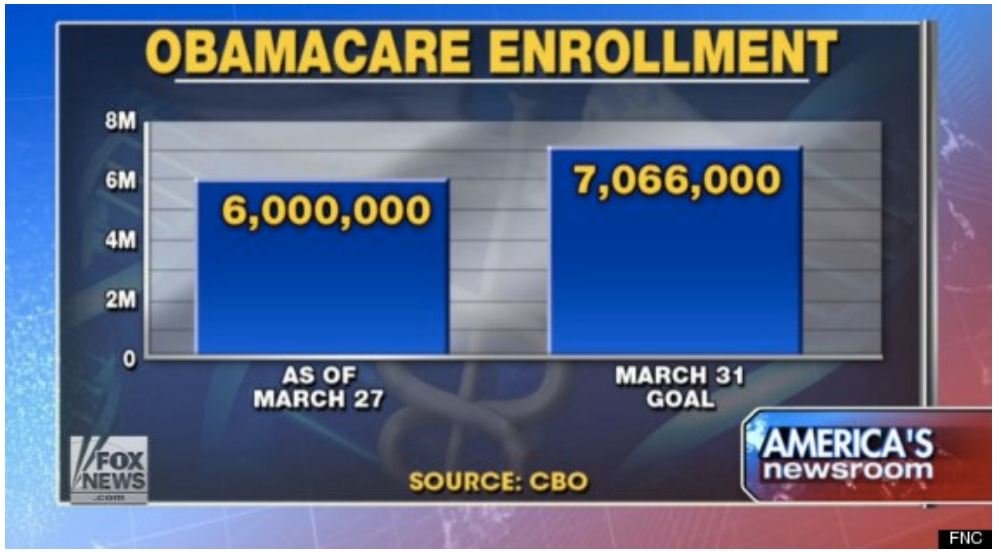

**Disclaim:** The point is to show the power of data integration rather than encourage you to work on De-Anonymization.

# Visualization

## Do you know visualization principles?

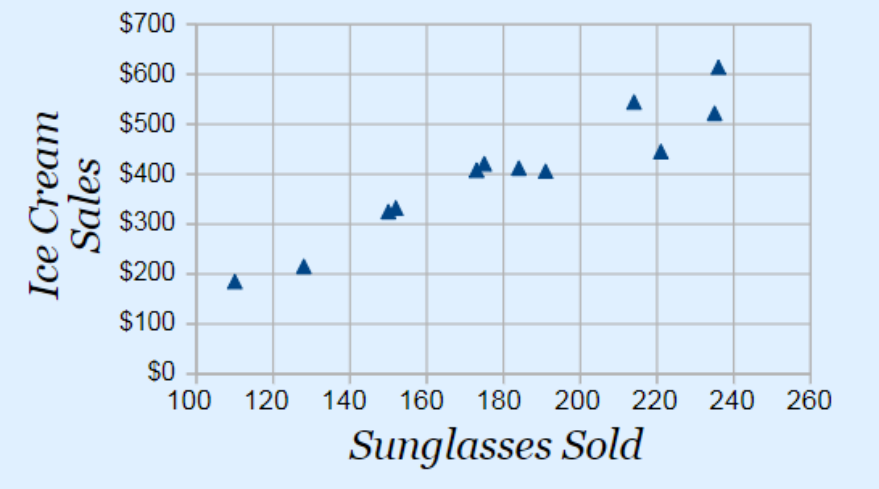
Without knowing the principles,
you might make a lot of mistakes like this!

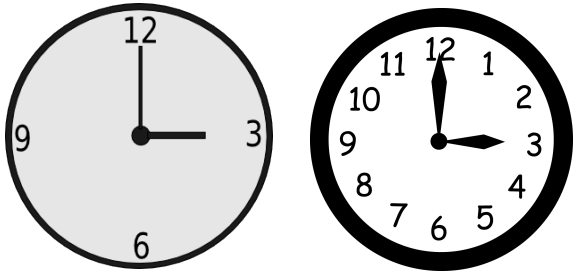


# Statistics

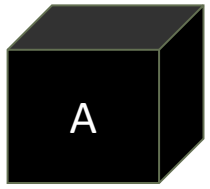
Do you know <u>correlation ≠ causality</u>?



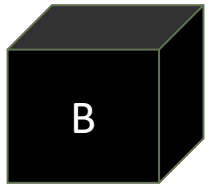
# Practical Machine Learning

## Do you know ML explanation?




Because it has wings and a beak

Bird: 99.0%




Because it is white and the background is blue

Bird: 99.9%

## Which model are you going to choose?

# Marking Scheme

Assignments: 11 x 3% = 33%

Quizzes: 3 x 3% = 9%

Blog Post:16%

- Depth (8%), Popularity (8%)

Final Project: 42%

- Proposal (2%), Milestone (10%), Poster (15%), Report (15%)

Bonus: Contribute to dataprep.ai (0.5%)

- Create an issue (0.2%)
- Send a pull request (0.3%)

# Major Deadlines

| When | What |
|---|---|
| Every Monday | Assignment Due |
| Monday Jan 18 | Form a team (2-4 members) |
| Monday Feb 12 | Blog Post Submission |
| Monday Feb 16 | Final Project Proposal |
| Monday Mar 12 | Final Project Milestone |
| Monday Mar 29 | Blog Post Popularity |
| April 12 | Final Project Presentation Session |
| April 18 | Final Project Video/Code/Report Submission |

| When | What |
|---|---|
| Monday Feb 8 | Quiz 1 |
| Monday Mar 8 | Quiz 2 |
| Monday Mar 29 | Quiz 3 |

# Lectures/Labs

## Lectures

- Monday 1:30 - 3:20

## "Lab" Hours

- Lab Session 1: Wed 9:30 AM - 10:30 AM, 2:30 PM - 3:30 PM
- Lab Session 2: Fri 9:30 AM - 10:30 AM, 2:30 PM - 3:30 PM

You can use your own computer for most of the work in the course.
You can also access the lab cluster (http://cluster.cs.sfu.ca/) **(Credit: Greg Baker)**

# Communications

## Web page

- Link: https://sfu-db.github.io/cmpt733
- Course information, lecture notes, and assignments

## Google form

- Link: http://tiny.cc/733-feedback
- Provide anonymous feedback to improve courses

## Canvas Discussion

- Link: https://canvas.sfu.ca/courses/60414/discussion_topics

# Policy

## Don't be Late

- Everyone has a budget of 2 days to be used on assignments
- Once it is used up, 20% per day for each late day

## Don't Cheat

- We will do plagiarism check
- If you got caught, your final mark would be deducted by 30%

**If you are struggling, let us know!**

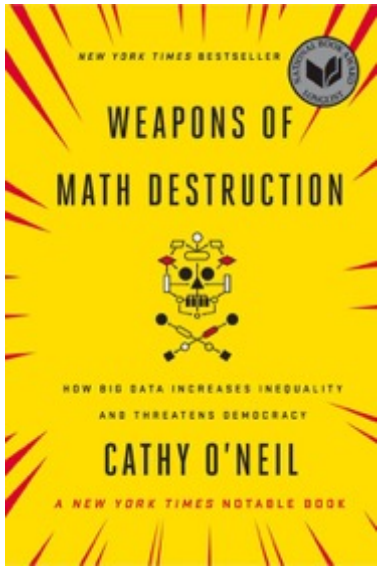
# The Last But Not The Least

## Data science could be harmful

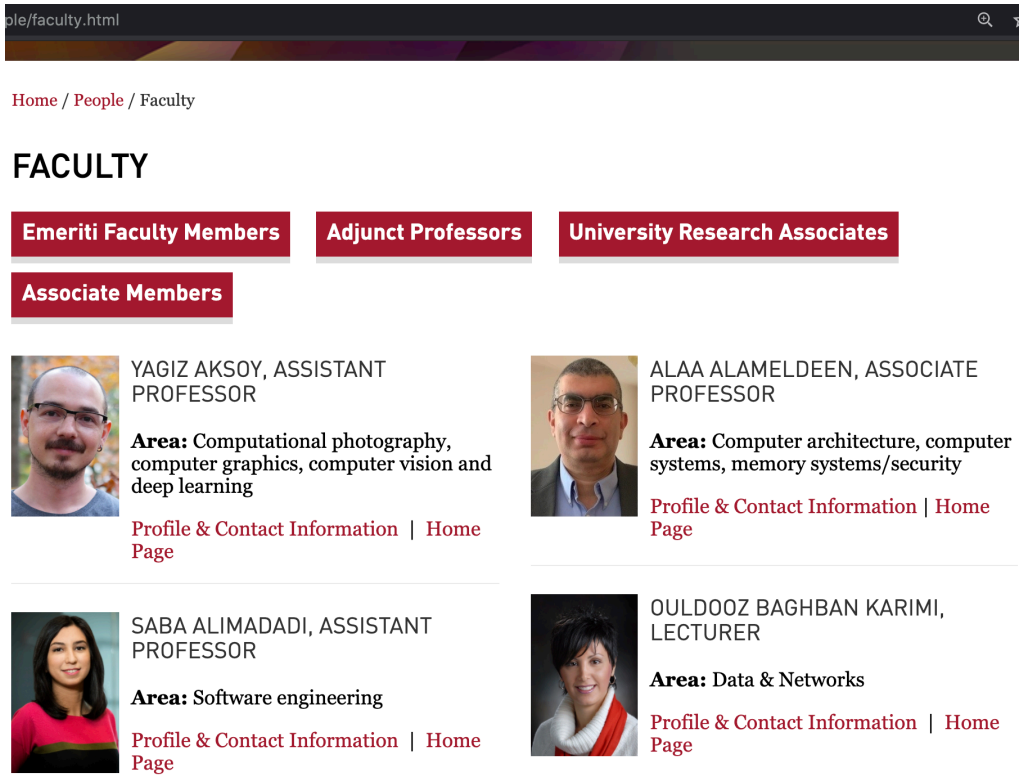
- Kill jobs, increase inequality, threaten democracy

## Don't be evil!

or



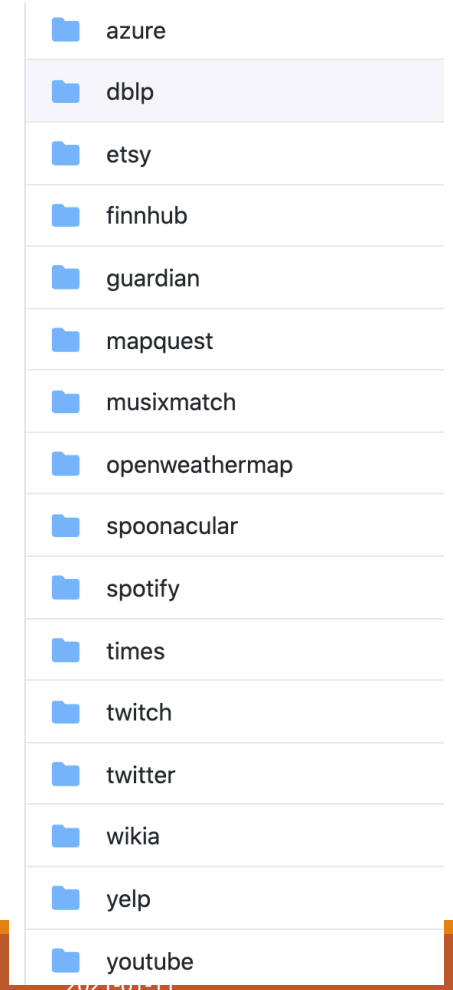
# Assignment 1-1: Web Scraping




faculty_table

| name | rank | area | profile |
|---|---|---|---|
| Yagiz Aksoy | Assistant Professor | Computational Photography, Computer Graphics, Co | http://www.sfu.ca/con |
| Saba Alimadadi | Assistant Professor | Software Engineering | http://www.sfu.ca/con |
| Brad Bart | Senior Lecturer | Instruction | http://www.sfu.ca/con |
| Andrei Bulatov | Professor | Constraint Satisfaction, Complexity Of Computation | http://www.sfu.ca/con |
| Sheelagh Carpendale | Professor | Information Visualization | http://www.sfu.ca/con |
| Angel Chang | Assistant Professor | Natural Language Processing, Artificial Intelligence, C | http://www.sfu.ca/con |
| Victor Cheung | Limited-Term Lecturer | Human-Computer Interaction, Interface And Interactic | http://www.sfu.ca/con |

# Assignment 1-2: Web APIs




**Yelp -- Collect Local Business Data**

- What's the phone number of Capilano Suspension Bridge Park?
- Which yoga store has the highest review count in Vancouver?
- How many Starbucks stores in Seattle and where are they?
- What are the ratings for a list of resturants?

Group Assignment: https://coursys.sfu.ca/2021sp-cmpt-733-g1/pages/Web-API-Assignment/view