Data Mining and Machine Learning

Fall 2019

Michalis Vlachos

UNIL | Université de Lausanne

Introduction

What is Data Mining?

Tools for Data Economy

- We live in an Information (Data) Economy
- Every physical or digital transaction generates some data. This trend will continue to grow.
- Especially with the growth of social networks, we can learn much more about what our clients do, like, and connect with.

How much data exists today?

- By 2020 there will be 40 zettabytes of data.
  - 1 ZB = 10^9 Terabytes
- If printed in textbooks, the stack of textbooks would reach to Pluto and back 20,000 times.

Data Mining – various definitions

Data Mining (DM) = Use of mathematical methods (regression, clustering, classification, deep learning) to extract patterns and **actionable** information from large amount of data (=Big Data)

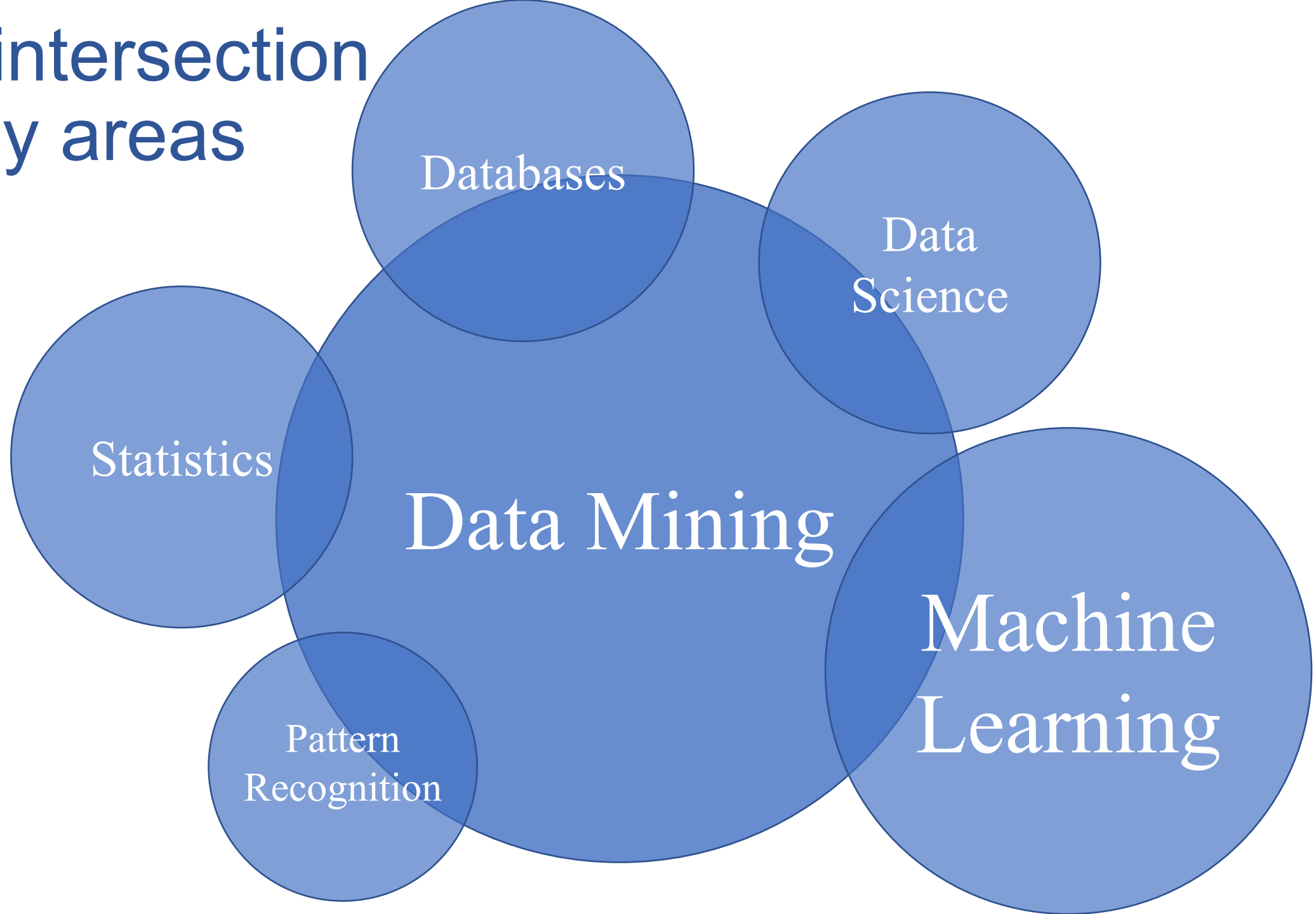
Data mining is the nontrivial extraction of **implicit**, **previously unknown**, and **potentially useful** knowledge from data (Frawley et al., 1992)

Data science + machine learning + visualization = Data Mining

my definition

One thing is for sure, DM the first field that understood the big data trend

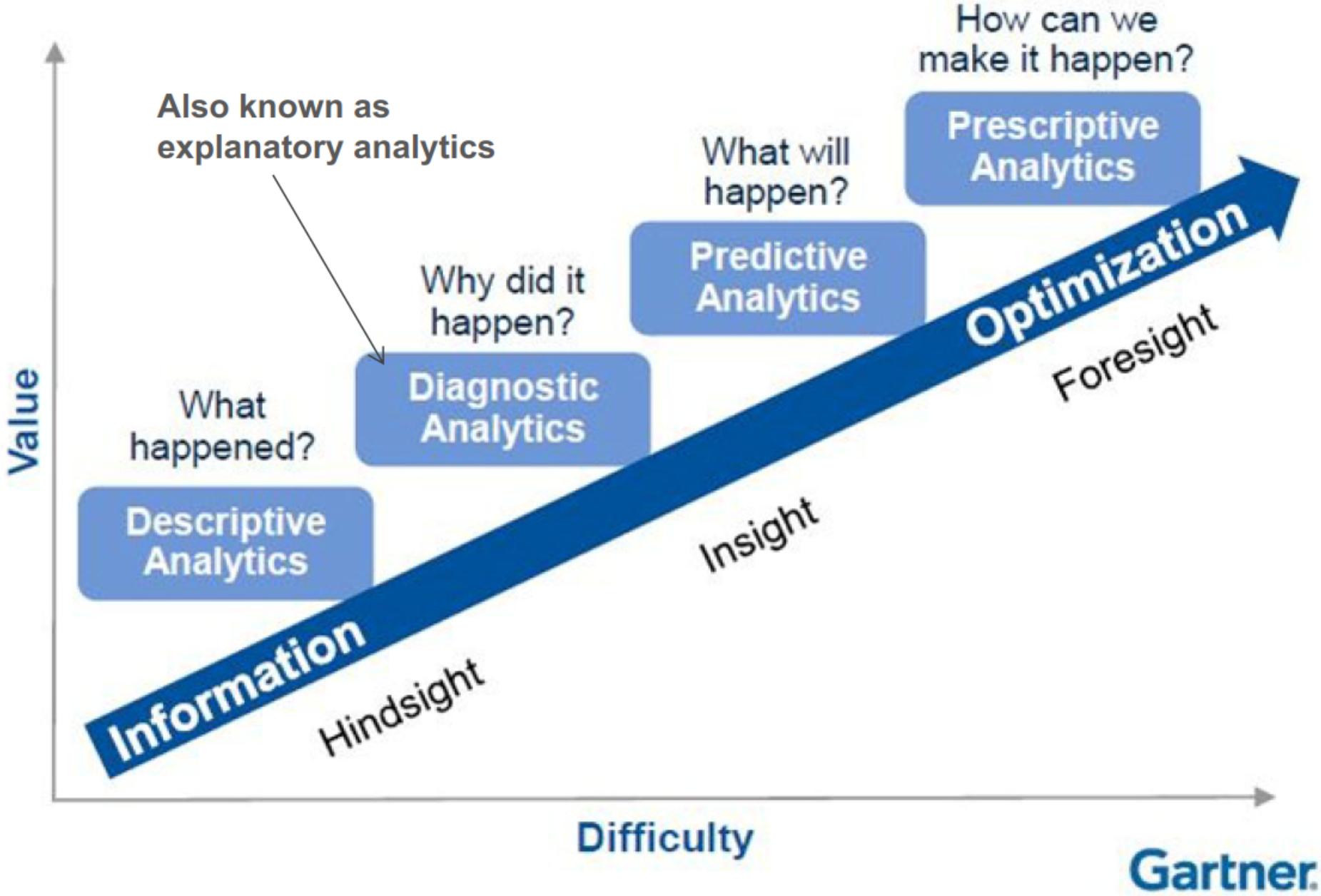
At the intersection of many areas



Goals of Data Mining

Goals:

- **Improve processes**
  - A hospital realizes patients in emergencies take too long to process
- **Understand your clients**
  - Do we serve our customer needs with our products?
- **Increase productivity**
- **Improve efficiency**


How can we make it happen?
Also known as explanatory analytics
Prescriptive Analytics
What will happen?
Predictive Analytics
Why did it happen?
Diagnostic Analytics
What happened?
Descriptive Analytics
Optimization
Foresight
Insight
Information
Hindsight
Value
Difficulty
Gartner

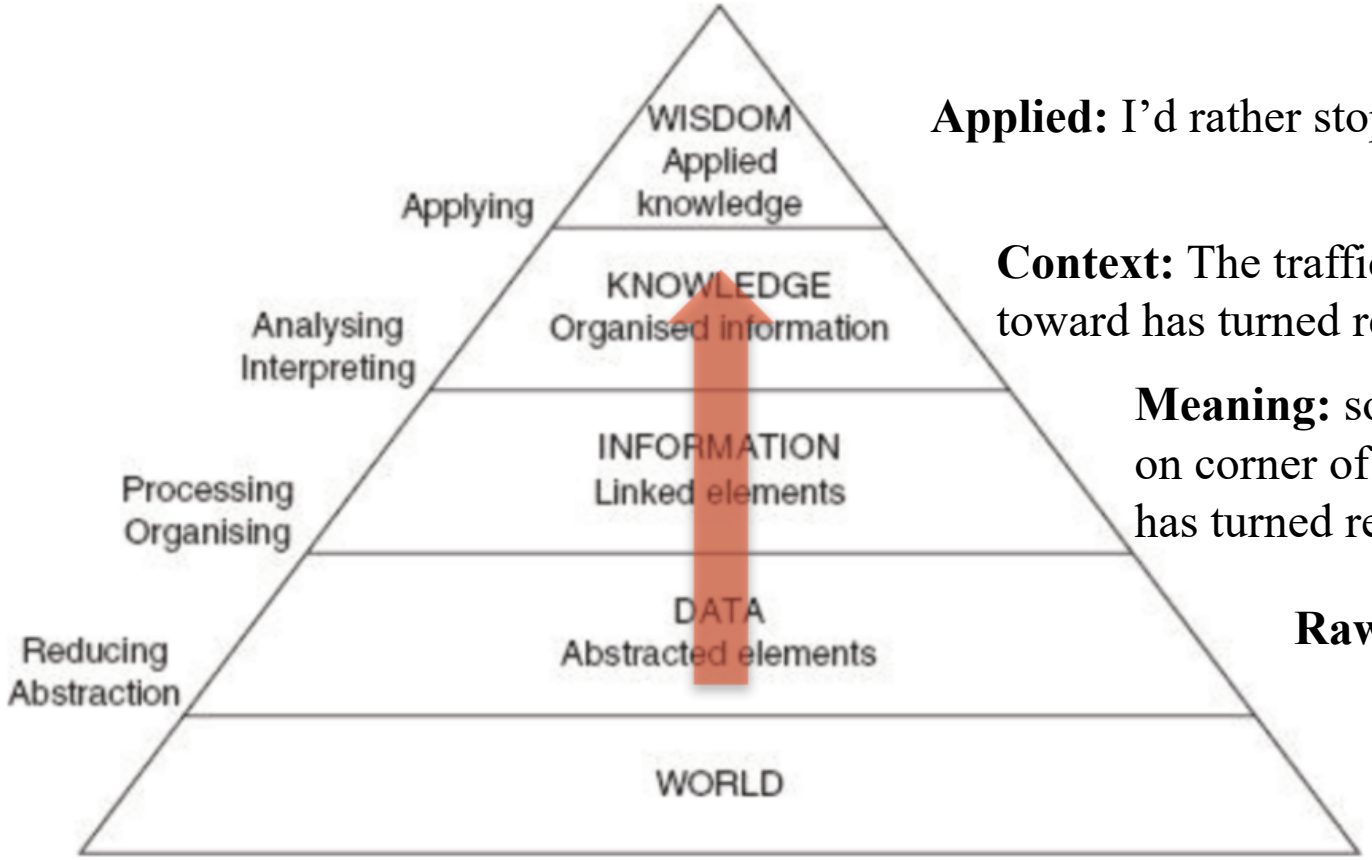
Data = knowledge?

- **Data** = simple, isolated facts (e.g. values in a database table)
- **Information** = data in context
- **Knowledge** = interpreted information
- **Intelligence** = use of knowledge to choose between alternatives
- **Wisdom** = intelligence + experience (guided by values and commitment)

data < information < knowledge

- without data, there can be no information and
- without information, there can be no knowledge

From Data To Wisdom - Example



Applied: I'd rather stop the car

Context: The traffic light I'm driving toward has turned red

Meaning: south facing traffic light on corner of Pitt and George street has turned red

Raw: red

Traffic light

There exist many tools to perform analytics and data mining. We will be focusing on Python in this class.

1. We will build some techniques from scratch.

2. We will learn how to use existing libraries.

Question

Why should you take a data scientist with you in the jungle?

Answer: Because they take care of the python problems.

What is Machine Learning?

What is ML?

It is a branch of Artificial Intelligence.

"**Machine learning** is the science of making computers learn and act like humans by feeding data and information without explicitly being programmed"

What does the previous definition mean?

	customerID	TotalCharges
0	7590-VHVEG	29.85
1	5575-GNVDE	1889.5
2	3668-QPYBK	108.15
3	7795-CFOCW	1840.75
4	9237-HQITU	151.65

If I give you this table, do you know how to write a program (i.e., rules, flow) to compute the **total charges**?

What does the previous definition mean?






If I give you some images, can you write code that recognizes if something is a car?

This is much more complicated.

What does the previous definition mean?

car

car

car

car

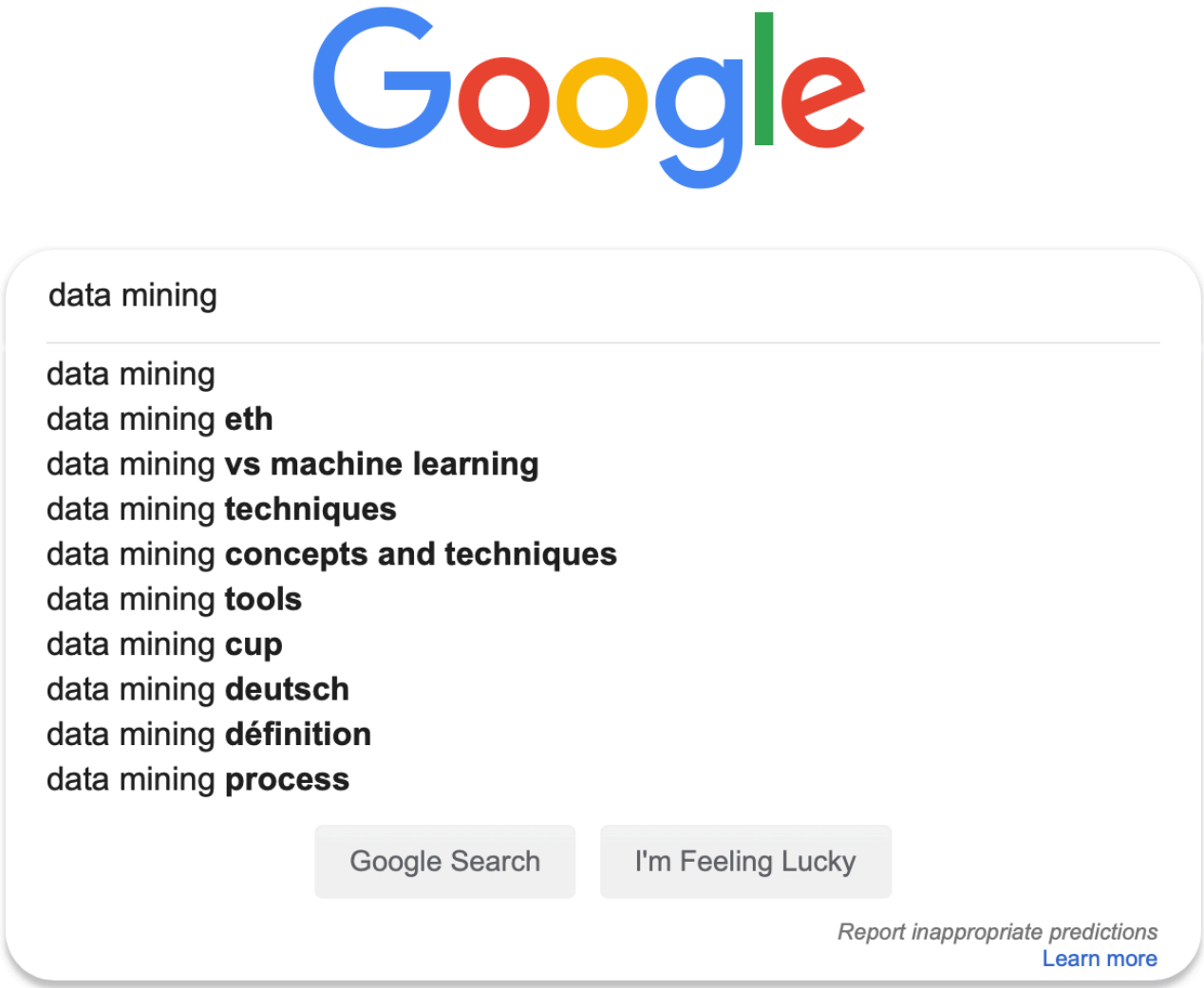
car

car

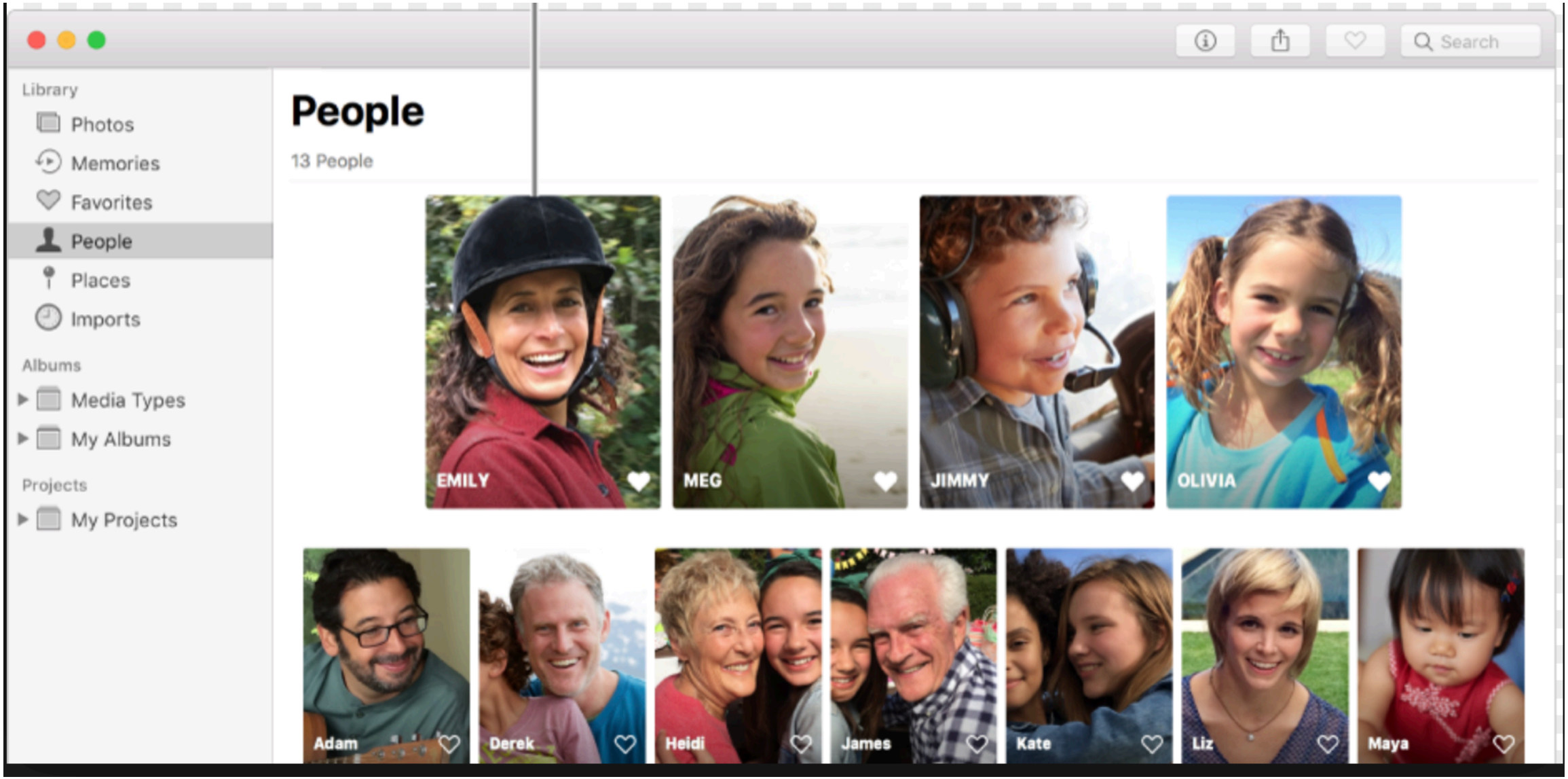
Instead, you write a very generic program that “learns by examples”.

So you can apply this to recognize or “predict” anything (cars, apples, …, stock price will increase,…)

Example of ML: autocomplete in search engines



Example of ML: person detection in iPhoto



Work in Two: Travallier à deux

- [3mins] Work with your neighbor.
- Do you think Machine Learning will match at some point in the future the human intelligence? When?

- [3mins] We discuss.

What is the difference between Data Mining and Machine Learning?

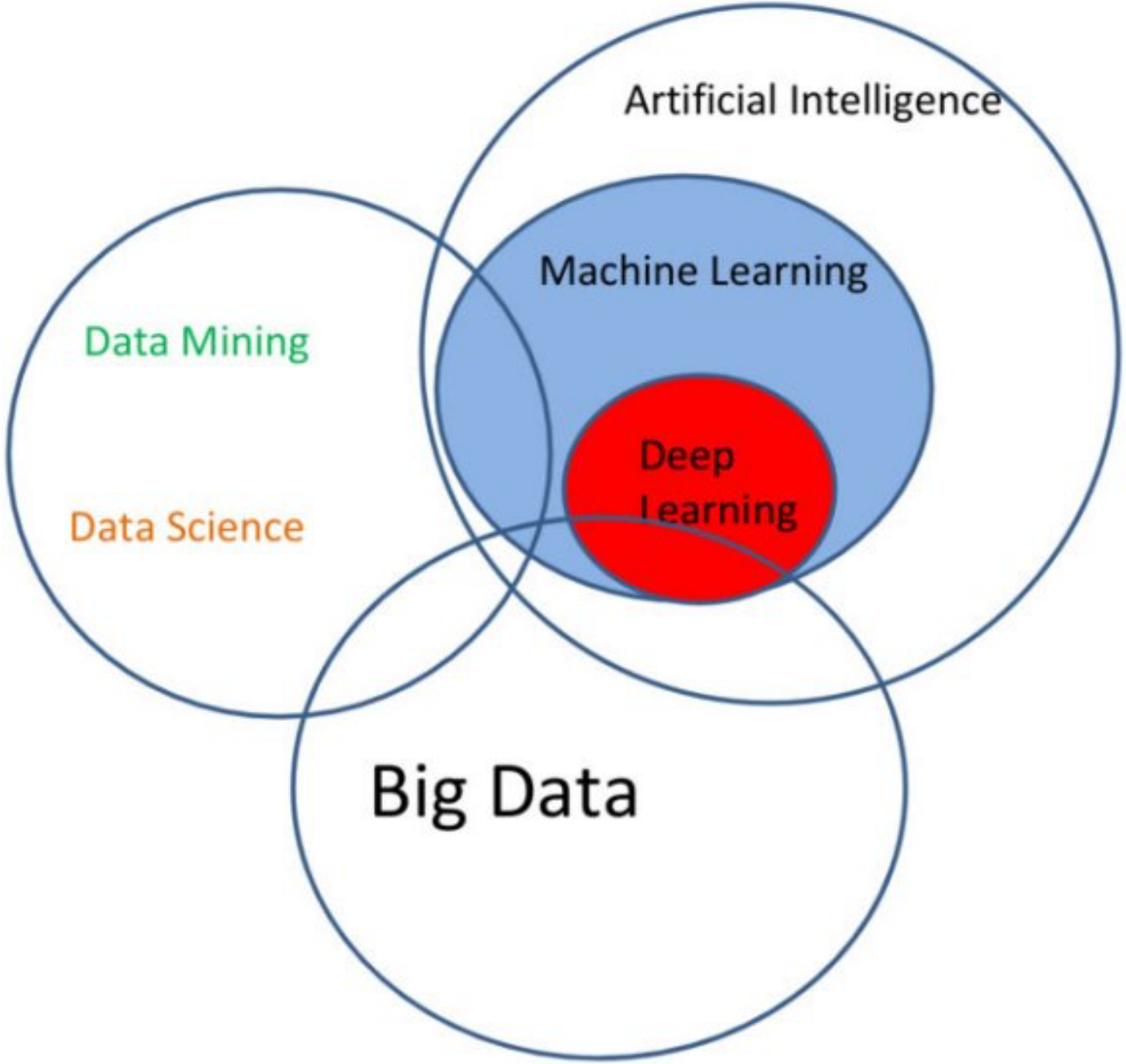
Historical Differences

- In the ‘80s, ’90s, 2000 Machine Learning was only interested in the “learning” part. How to make a better model that gives better **accuracy**: e.g., detects images of cars more accurately.
- Data mining in the ’90s was more focused on the **data-scale** part. How to make existing machine learning algorithm, e.g., clustering, applicable for large amount of data through sampling, summarization, etc.

Today's Differences

- Today, these differences are more nuanced as the two fields converge into one.
- Today, you can say data mining deals will the search, cleaning, processing, storage of the data. Machine learning deals with the creation and tuning of the proper learning model.

The big picture



your expectations

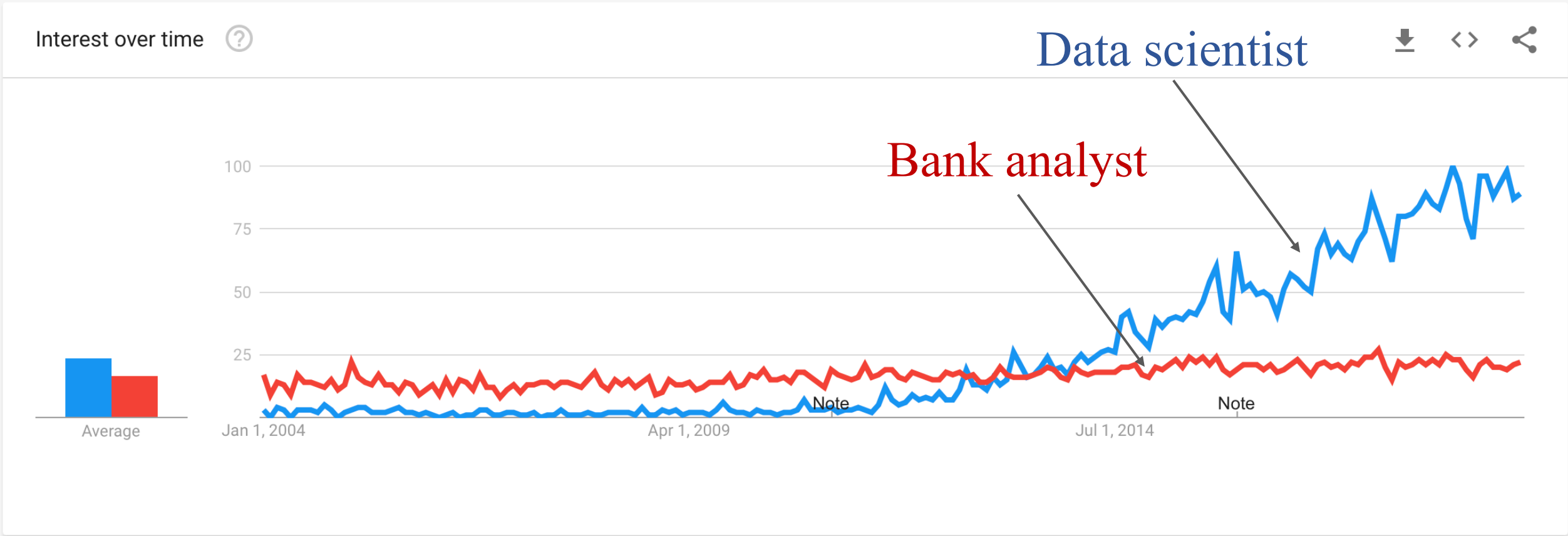
1. Why you enrolled in the class?
2. What do you expect to learn?

Take the class survey

https://tinyurl.com/DM-survey2019

Why follow this class

- You want to land a job as a data scientist.
- You want to enhance your coding skills in Python.
- You want to understand what the whole AI buzz is about.
- You want to publish papers in the area and receive a PhD.


Interest over time
Data scientist
Bank analyst
100
75
50
25
Note
Note
Average
Jan 1, 2004
Apr 1, 2009
Jul 1, 2014

ARTWORK: TAMAR COHEN, ANDREW J BUBOLTZ, 2011, SILK SCREEN ON A PAGE FROM A HIGH SCHOOL YEARBOOK, 8.5" X 12"

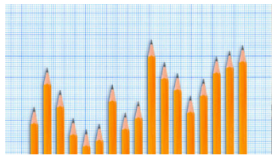
DATA

Data Scientist: The Sexiest Job of the 21st Century

by Thomas H. Davenport and D.J. Patil

FROM THE OCTOBER 2012 ISSUE

WHAT TO READ NEXT



What Data Scientists Really Do, According to 35 Data Scientists

Class goals

1. Approach problems data-analytically
   - Think carefully & systematically about whether and how data can improve performance

2. Be able to interact competently on the topic of data mining analytics
   - Know the basics of data mining processes, techniques, and concepts well enough

3. Receive hands-on experience mining data
   - You should be able to follow up on ideas or opportunities that present themselves

Course Logistics and Expectations

Requirements

- You should be comfortable using Python. If you don't, most likely you shouldn't be taking this class.
- Basic statistics and math
- You **have to** bring your laptop in-class (but not check emails, browse the internet, etc. Tough…I know!)

An important piece of advice: The class can be quite demanding. You will be expected to spend at least 6-8 hours per week on it. Most of it will be coding and also understanding and applying analytics concepts.

Grades and Course Load

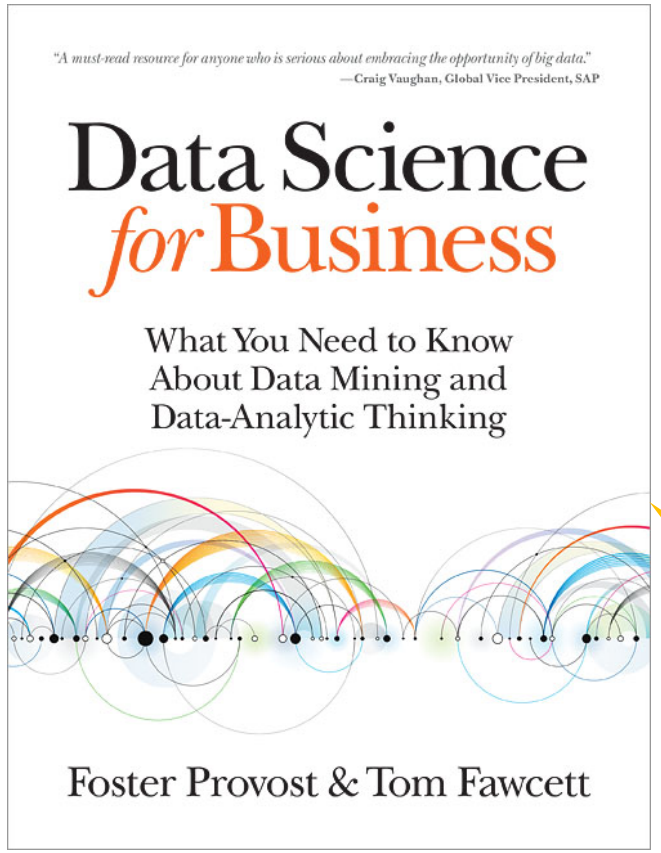
- **30%:** 4 in-class quizzes (20mins) – Lowest grade will be dropped.
- **30%:** Personal assignments. Report + Python + video (several days)
  - No late policies. Once submission is closed, it's closed.
- **30%:** One group project (several weeks)
- **10%**: Class participation: at least one post and one reaction/response to someone else's post on class slack channel **for 10 weeks.**
  - Example Post: You post a link to an interesting related article related to the week's topic you found in Times, the Economist, blogpost, etc and you explain how it relates to our material.
  - Example of good response: "The article here contradicts your statement, but still liked your post. I also believe that …"
  - Example of bad response: "You don't know what you are talking ab

Be civil and respect your fellow classmates.

Recommended Reading

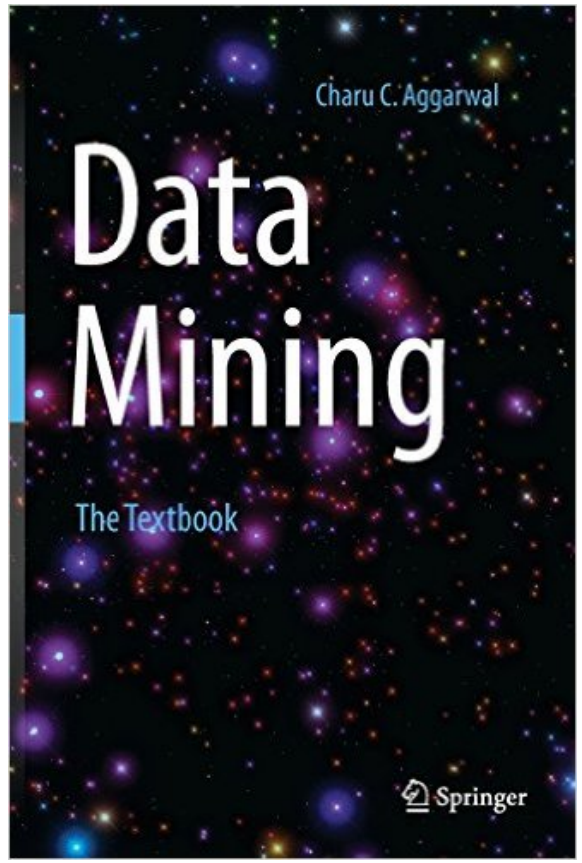
Purchasing any of those is neither necessary nor compulsory

Good for business focus



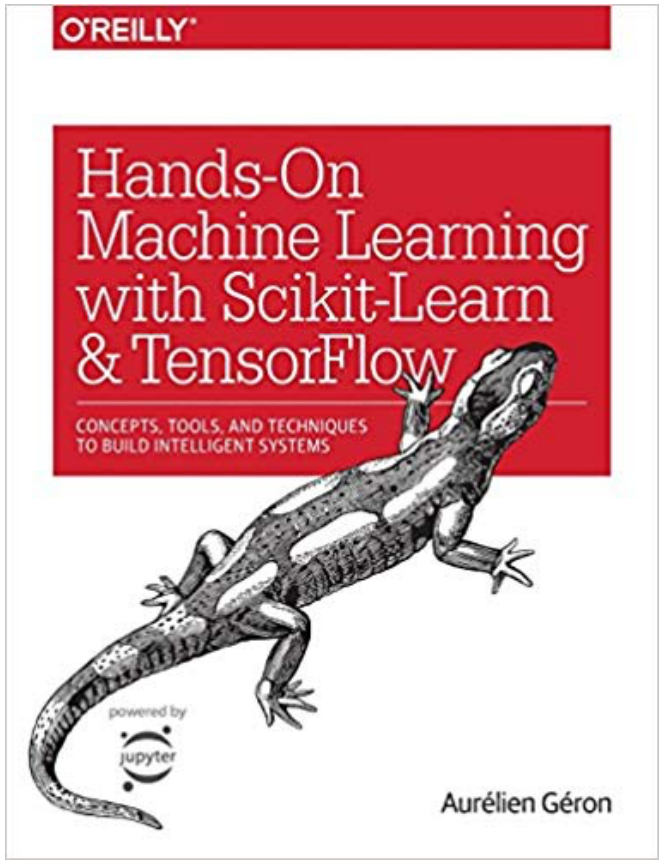
Tom Fawcett, Foster Provost, "Data Science for Business", O'Reilly Media, 2013 (ISBN 1449361323)

See the errata for the book here.

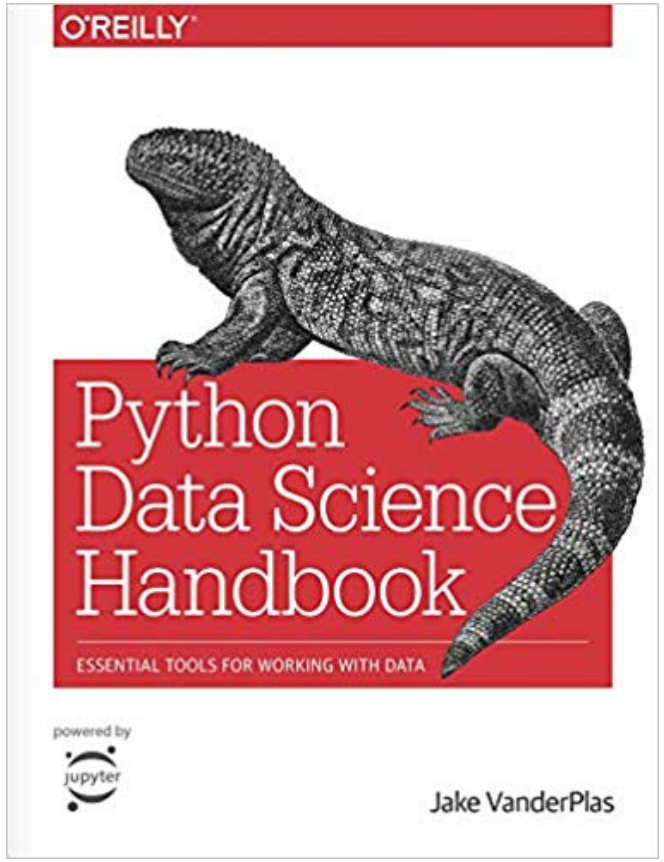


Data Mining: The Textbook by Charu C. Aggarwal.

Recommended Reading



More hands-on introduction with Python code.



If you have a question

- Ask your neighbor classmate
- Ask Google
- Post the question at the class slack channel
  - **https://bit.ly/33tNiPR** (click to join, but **use your UNIL email**)
  - The channel will be monitored daily, and it is also **your responsibility** as a student to visit it at least a few times per week and interact with your classmates. You get better, by helping others…
- Email me directly only for personal matters

Cheating Policy

- Respect academic honesty.
- Don’t cheat. As simple as that! If you are caught cheating (e.g., blatantly copying something that exists in the Internet) you will not receive any grade on your assignment and have further repercussions for your studies.
- Our goal is to learn in this class.
- If for an assignment you discussed with another classmate, this is OK. Just write it explicitly in your writeup: “I discussed question 5 with my friend John”.

Classroom behavior

- Put your phones in **silent mode** during class/lab. Imagine if everyone's phone was ringing at random times! In case you are a repeat offender (> 2 times), come and see me after the session to explain.
- You are encouraged to ask questions and initiate discussions during the class.

Applications

of Data Mining and Machine Learning

Promotions/discounts at Supermarkets

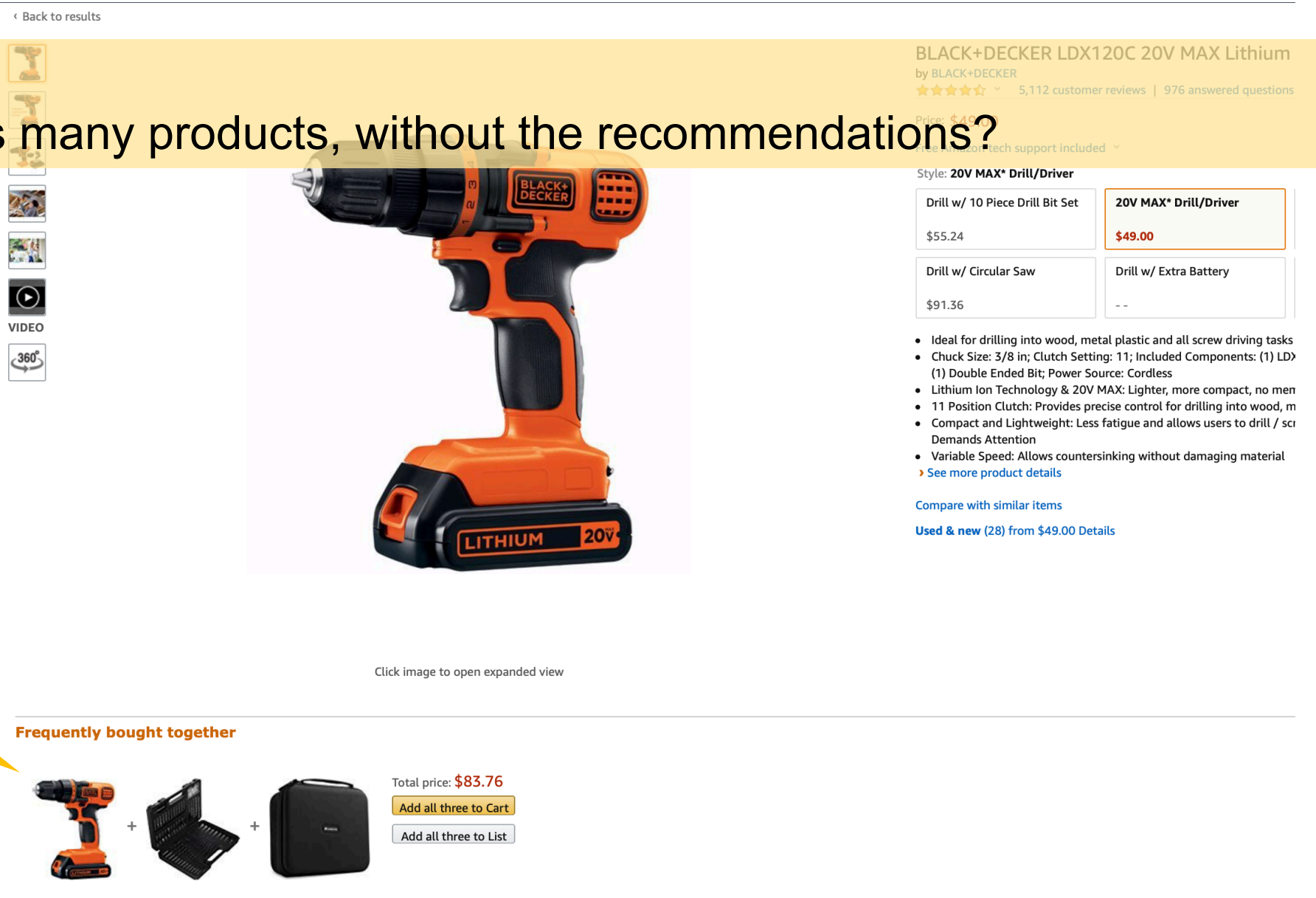
Sending out selected brochures/emails

Don’t just send brochures/emails to all clients. Only to those “most likely” to buy something.

Recommendations at Netflix

Would you have bought as many products, without the recommendations?

Things people buy together



Detecting Fake News

- Fake news = false, often sensational, information disseminated under the guise of news reporting

Pope Francis endorses Trump for president

All | Images | News | Videos | Shopping | More | Settings | To

About 1'600'000 results (0.31 seconds)

'Fake news' went viral in 2016. This expert studied who clicked.
https://www.nbcnews.com/.../fake-news-went-viral-2016-expert-studied-who-clicked-...
Jan 14, 2018 - But before "fake news" became **President Donald Trump's** favorite ... articles like " **Pope Francis** Shocks World, **Endorses Donald Trump For** ...

Pope Francis Shocks World, Endorses Donald Trump for President ...
endingthefed.com/pope-francis-shocks-world-endorses-donald-trump-for-president-rele...
No information is available for this page.
Learn why

Pope Francis Shocks World, Endorses Hillary Clinton for President
https://www.snopes.com › Fact Check › Junk News
Claim. **Pope Francis** has **endorsed** Hillary Clinton for **President**. ... reversed himself yet again and **endorsed Trump's** rival in the **presidential** race, Hillary Clinton:.


Stephen King
@StephenKing
Follow
The news is real. The president is fake.
6:38 PM - 9 Jul 2017
59,919
187,721

Launching a new product with Big Data

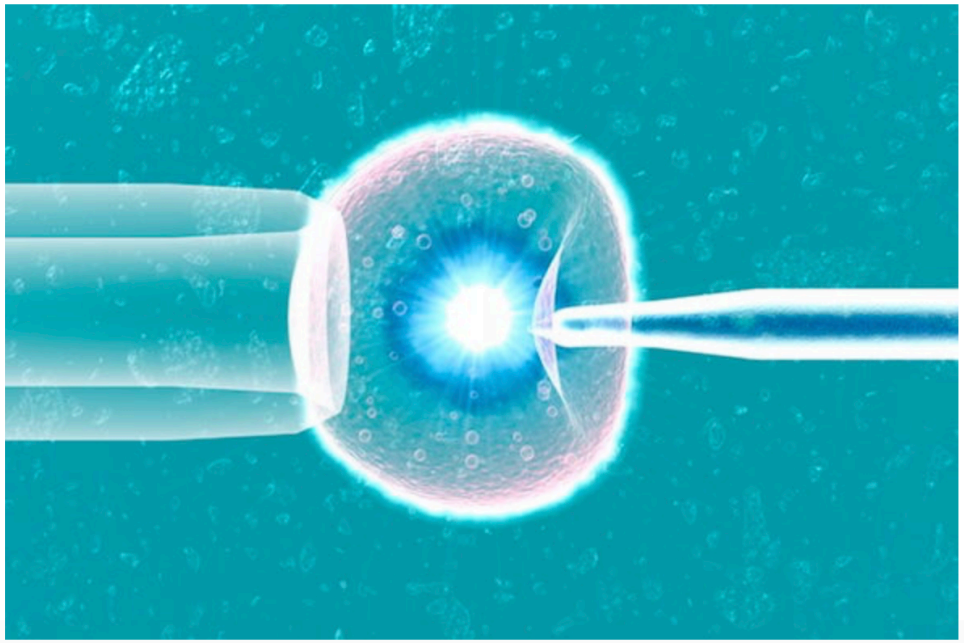
Starbucks was introducing a new coffee product but was concerned that customers would find its taste too strong. The morning that the coffee was rolled out, Starbucks monitored blogs, Twitter, and niche coffee forum discussion groups to assess customers' reactions. By mid-morning, Starbucks discovered that although people liked the taste of the coffee, they thought that it was too expensive. Starbucks lowered the price, and by the end of the day all of the negative comments had disappeared.

Which egg to use?

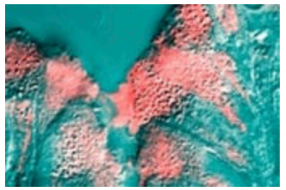
What AI Can Do for IVF

Up to two thirds of in vitro fertilization patients experience failed cycles—but AI systems might be able to flag the most viable embryos far better than humans can

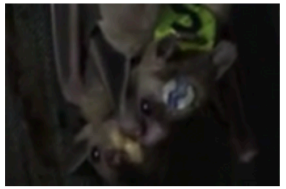
By Carol Lynn Curchoe, Charles L. Bormann on January 10, 2018



LATEST NEWS



Mucus: The Body's Unsung Hero

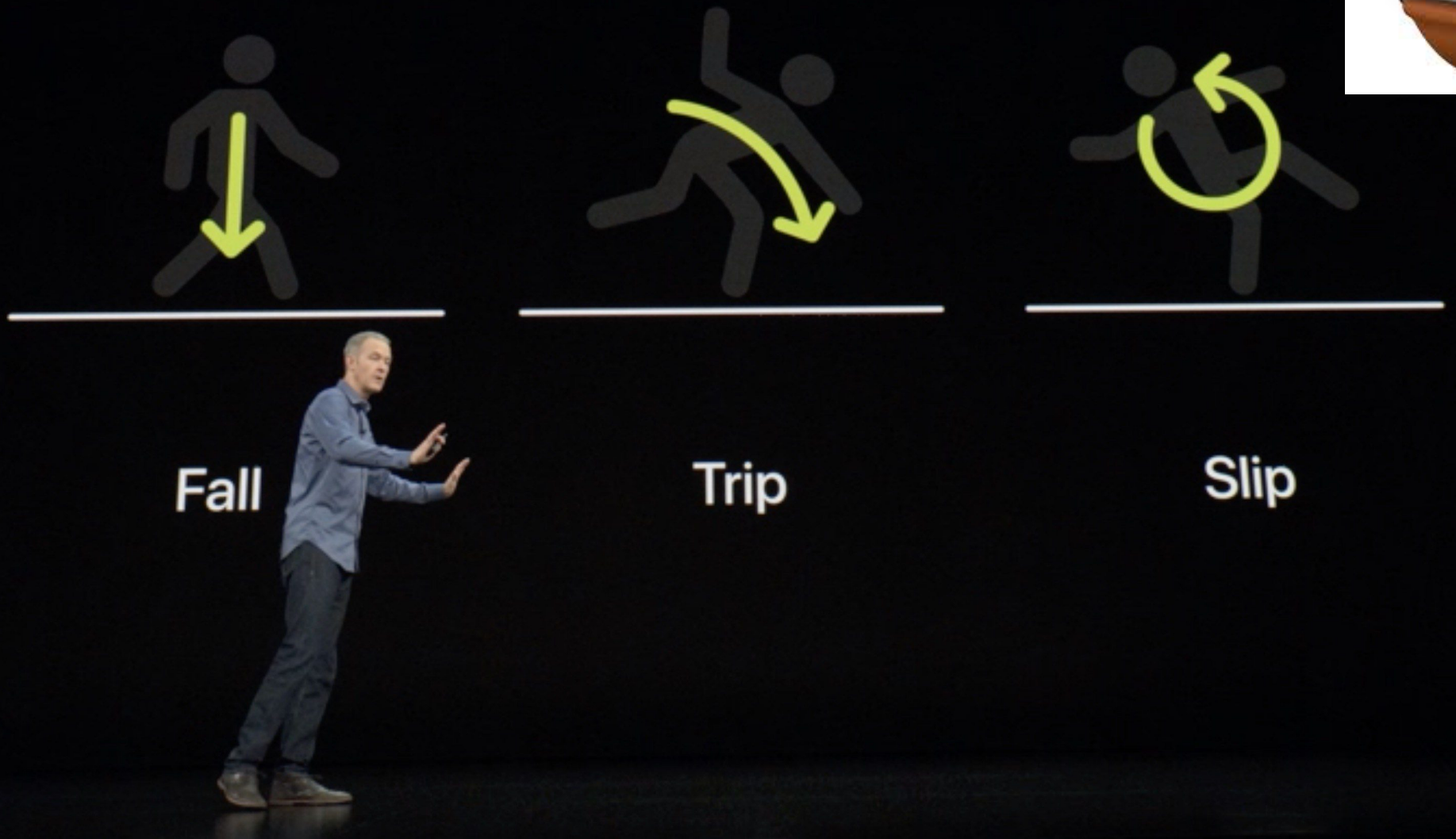


Male Bats Up Mating Odds with Mouth Morsels

New NASA Mission Will Fly Titan's Frigid Skies to Search for Life's Beginnings

https://blogs.scientificamerican.com/observations/what-ai-can-do-for-ivf/

Detecting a fall with Apple Watch

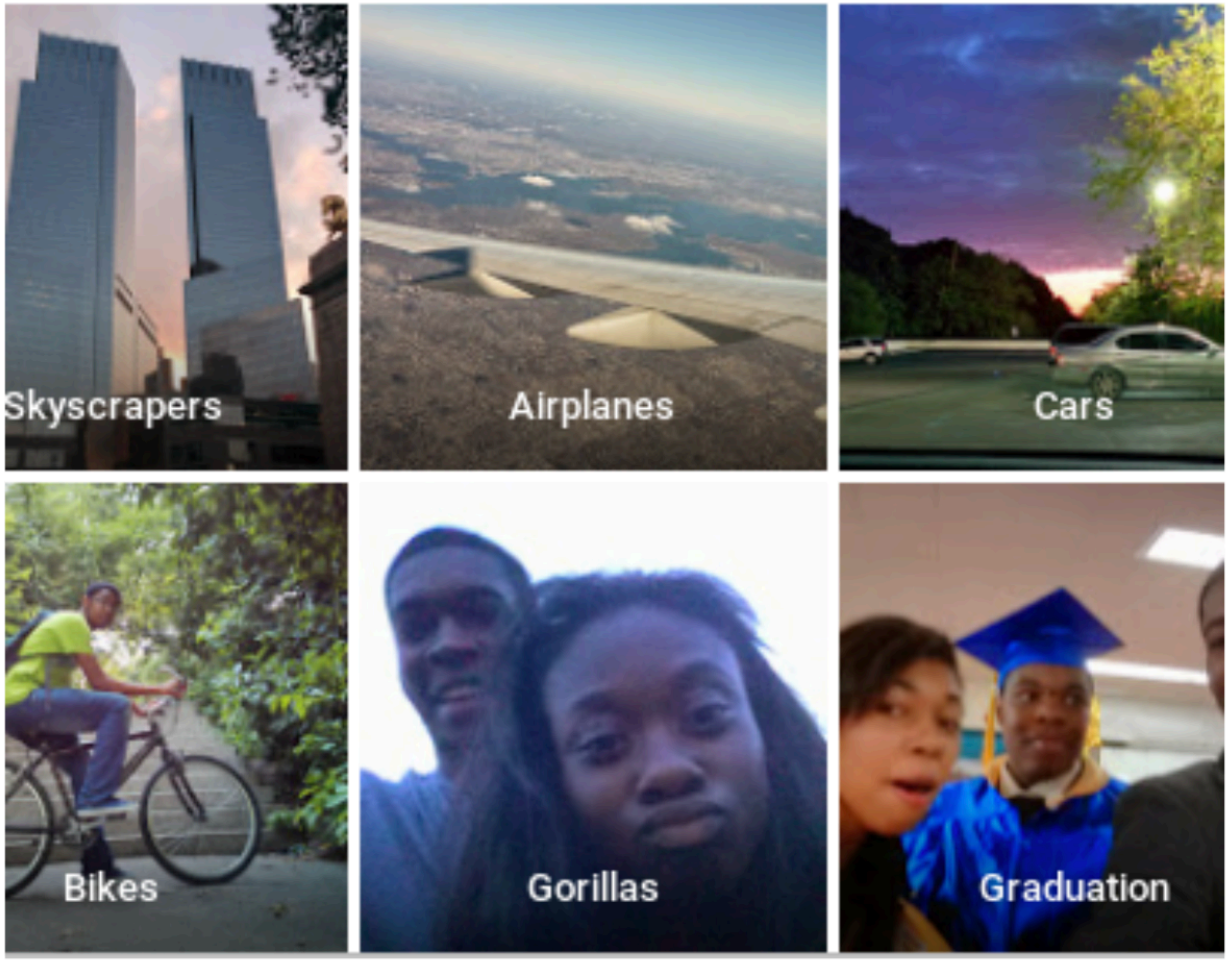


How about pitfalls?

- The previous were all success stories. Has there been any pitfalls?
- Algorithmic Bias

(read the above article at

a later time and discuss
in the class slack channel)



https://www.theverge.com/2018/1/12/16882408/google-racist-gorillas-photo-recognition-algorithm-ai

There are numerous mining or “learning” tasks

The majority of the previous examples were **classification** tasks, but there any many more

- Regression
- Clustering
- Outlier Detection
- Association Rules
- Recommendations
- Similarity Search

Data Mining – Why now?

Arthur C Clarke
~ 1974

Data-mining

Why? Why now? Confluence of 4 technical advances:

1. **Storage**
   - Disk densities have been doubling each year
   - A $100 disk today has 1,000,000× more capacity/$ than the disks of 30 years ago
2. **Networking / Internet**
   - Data can be transferred easily between collection, storage, and use
   - eBusiness systems do it as a matter of course (w/ fewer data errors)
3. **Algorithms**
   - Advanced algorithms from machine learning, pattern recognition, and applied statistics have become mature enough for mainstream use
4. **Computing power**
   - Processing power has been doubling every 1.5 years or so (Moore's law)
   - Laptops are more powerful than the supercomputers of yesteryear

All four of these are essential for effective, successful data mining

Data-mining

5. Data

We never generated and collected more data than now

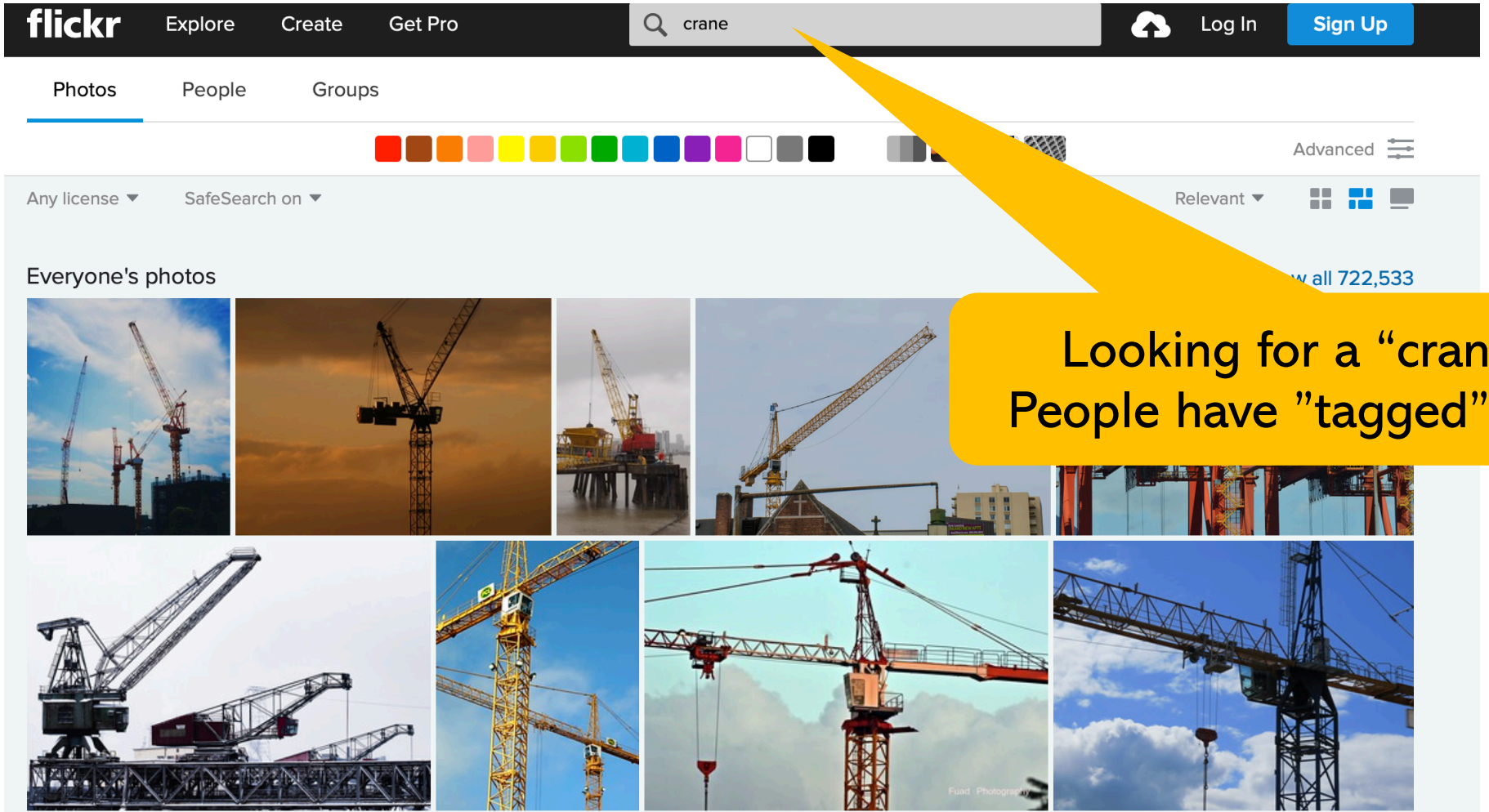
> "More data was created in the past two years than in the entire previous history of mankind."

"Big data" is "data mining"

Data-mining

6. Users

Learning algorithms need training ("labeled") data. We/you provide those!



Data-mining

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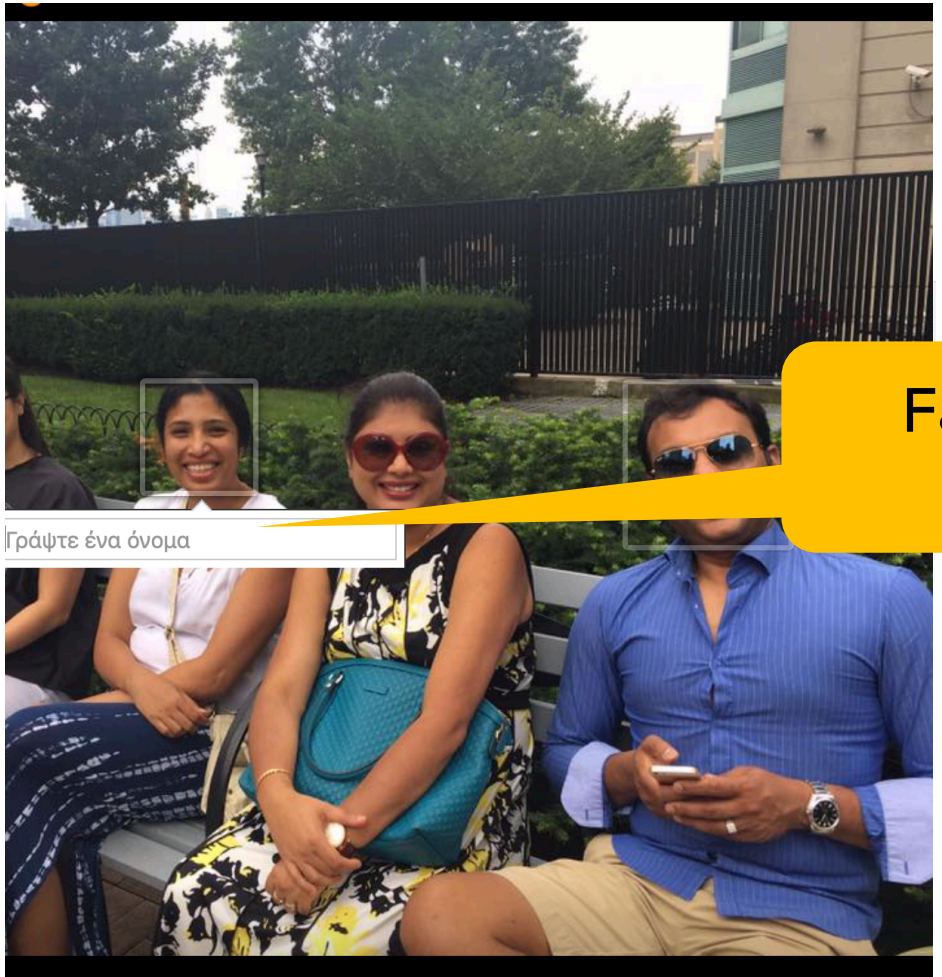


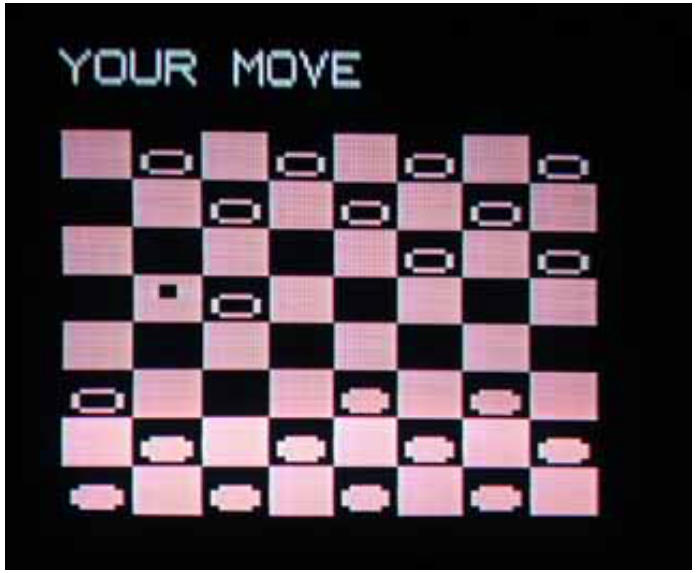
Facebook urges you to “write a name” and label the face!

A Brief History of Data Mining and Machine Learning

- 1700s: Bayes theorem: understand complex realities based on probabilities. It is to the theory of probability what the Pythagorean theorem is to geometry.
- 1800s: Regression analysis.
- 1950: "Computing Machinery and Intelligence", aka Turing's Test
- 1956: Term "Artificial Intelligence" introduced at Dartmouth Conference
- 50s-60s: Golden years
  - 50s: neural networks, genetic algorithms, clustering
  - 60s: decision trees

Samuel's checkers program

- 1959: Arthur Samuel's computer program learns to play checkers better than humans, given past games as examples.



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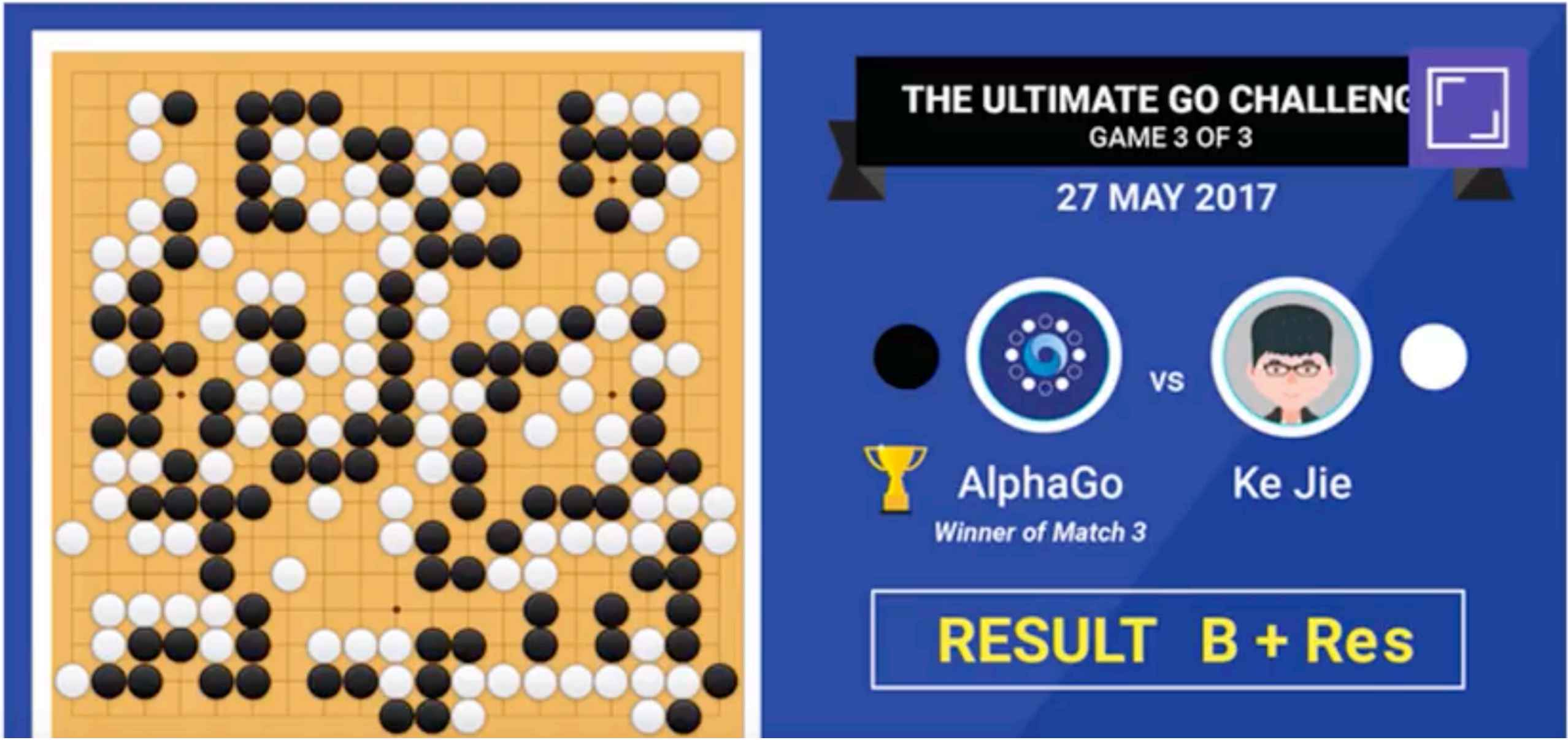
- 1956: Artificial Intelligence term introduced at Dartmouth Conference
- 50s-60s: Golden years
  - 50s: neural networks, genetic algorithms, clustering
  - 60s: decision trees
- 70s-80s: AI winter

- 1988: “A statistical approach to Language Translation”
- 1989: First conference on Data Mining (KDD)
- 1991: The birth of Internet
- 1994: Association Rules
- 1997: Deep Blue defeats Garry Kasparov
- 2001: Product recommendations on Amazon
- 2011: IBM Watson wins human at TV game Jeopardy!
- 2012: Power of deep Learning
- 2014: Neural Machine Translation
- 2015: Machines “see” better than humans
- 2016: Google’s AlphaGo (deep learning, reinforcement learning)
- 2018: Self-driving taxis

Google's DeepMind project "AlphaGO", a computer program that plays the board game 'GO' has defeated the world's number one Go player Ke Jie



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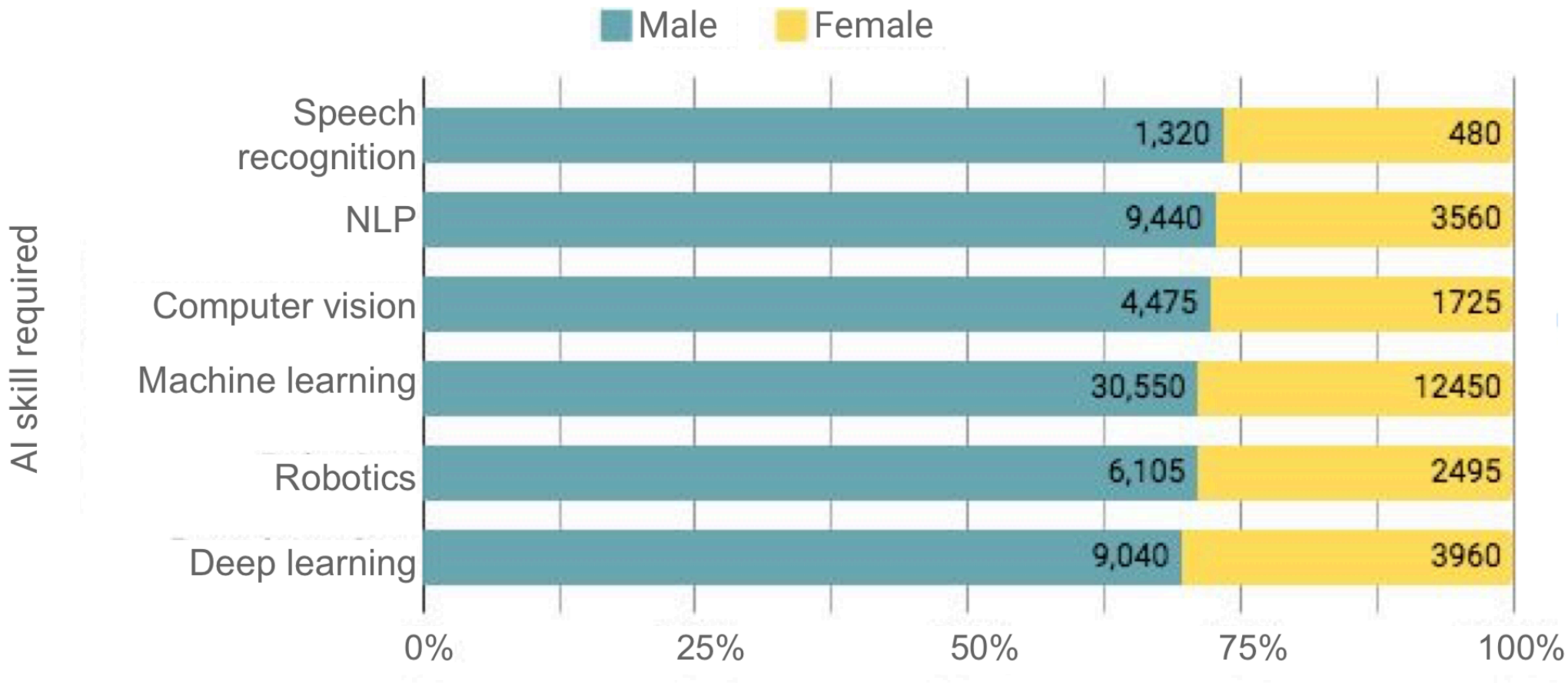
- 2018: Self-driving taxis
- **2019: Class on “Data Mining and ML” (your personal milestone)**

Current state of ML/AI

- If you want to see where Machine Learning stands today and to understand its growth, you can visit aiindex.org



Techniques

Regression, Classification, Outlier/Anomaly Detection,
Association Rules, Recommendation

Finding the price of a house

CHF 500’000

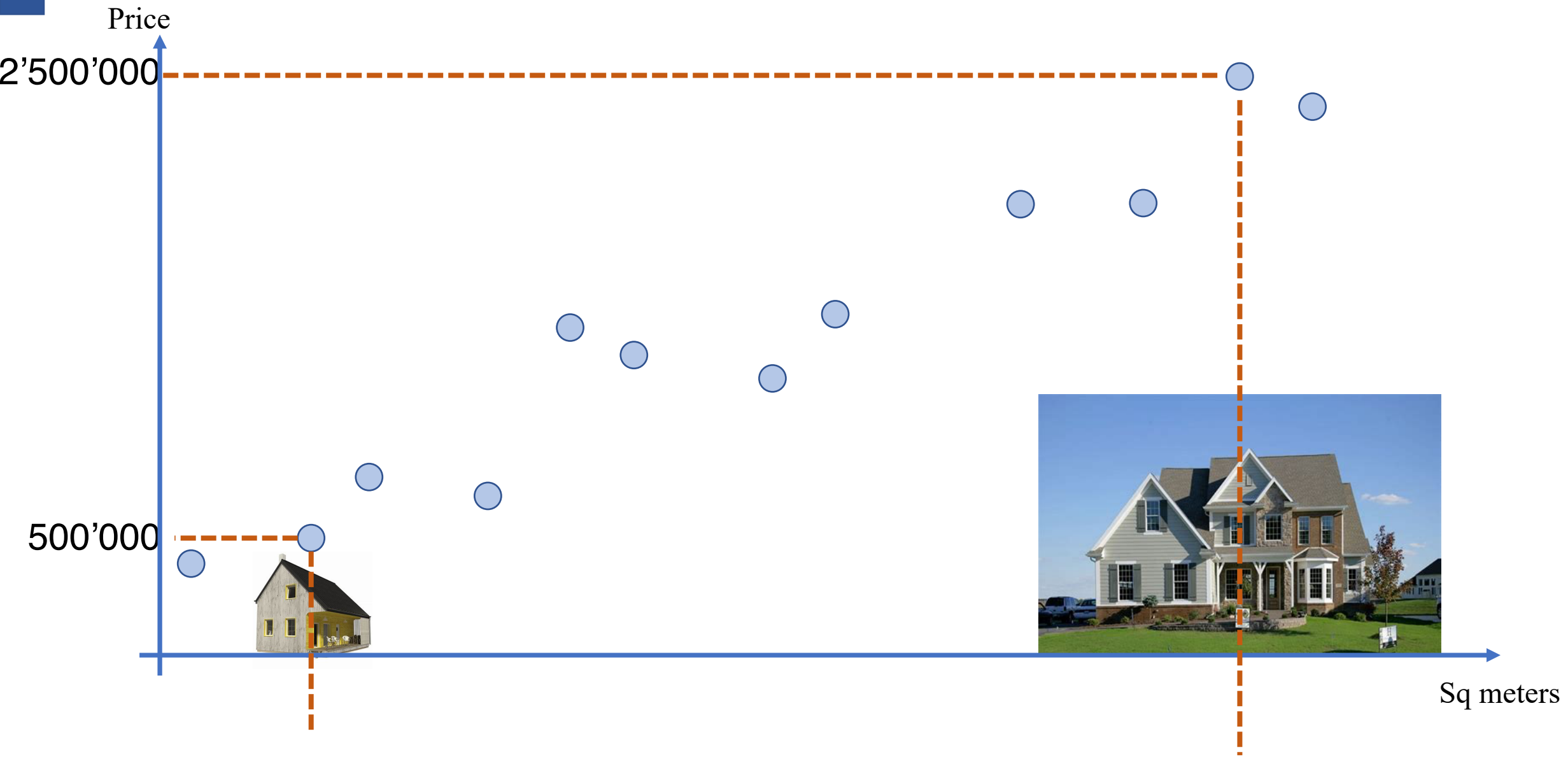
?

CHF 2’500’000

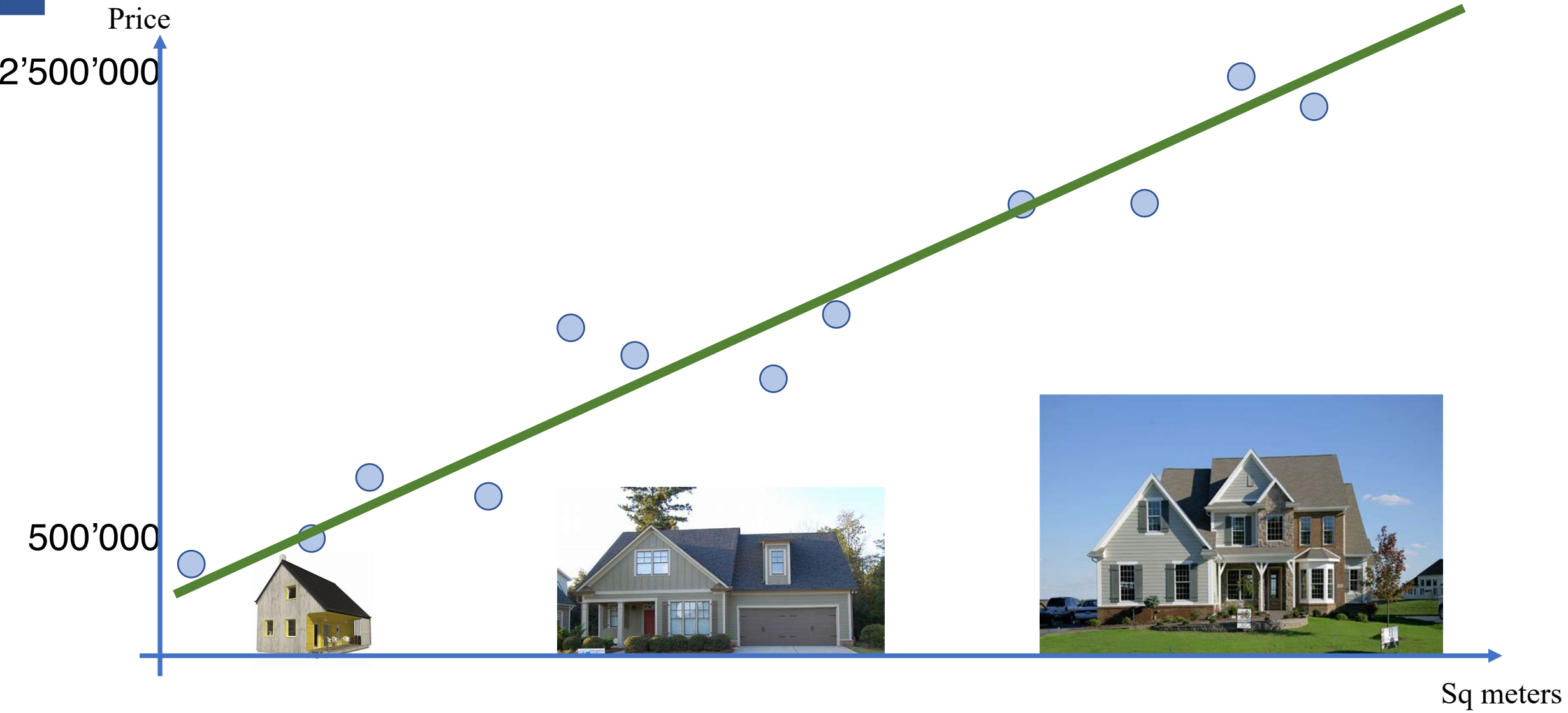
Finding the price of a house

Sq meters

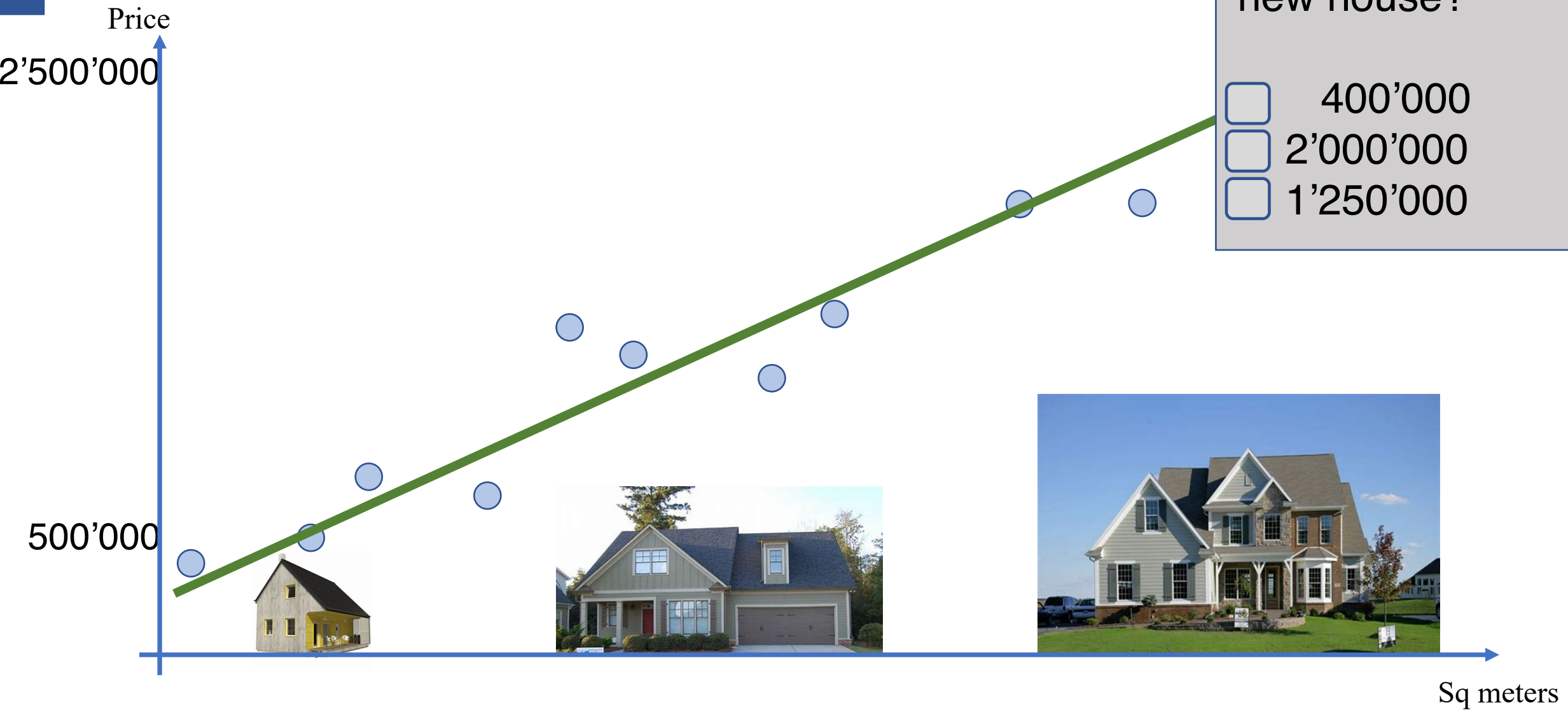
Finding the price of a house



Finding the price of a house



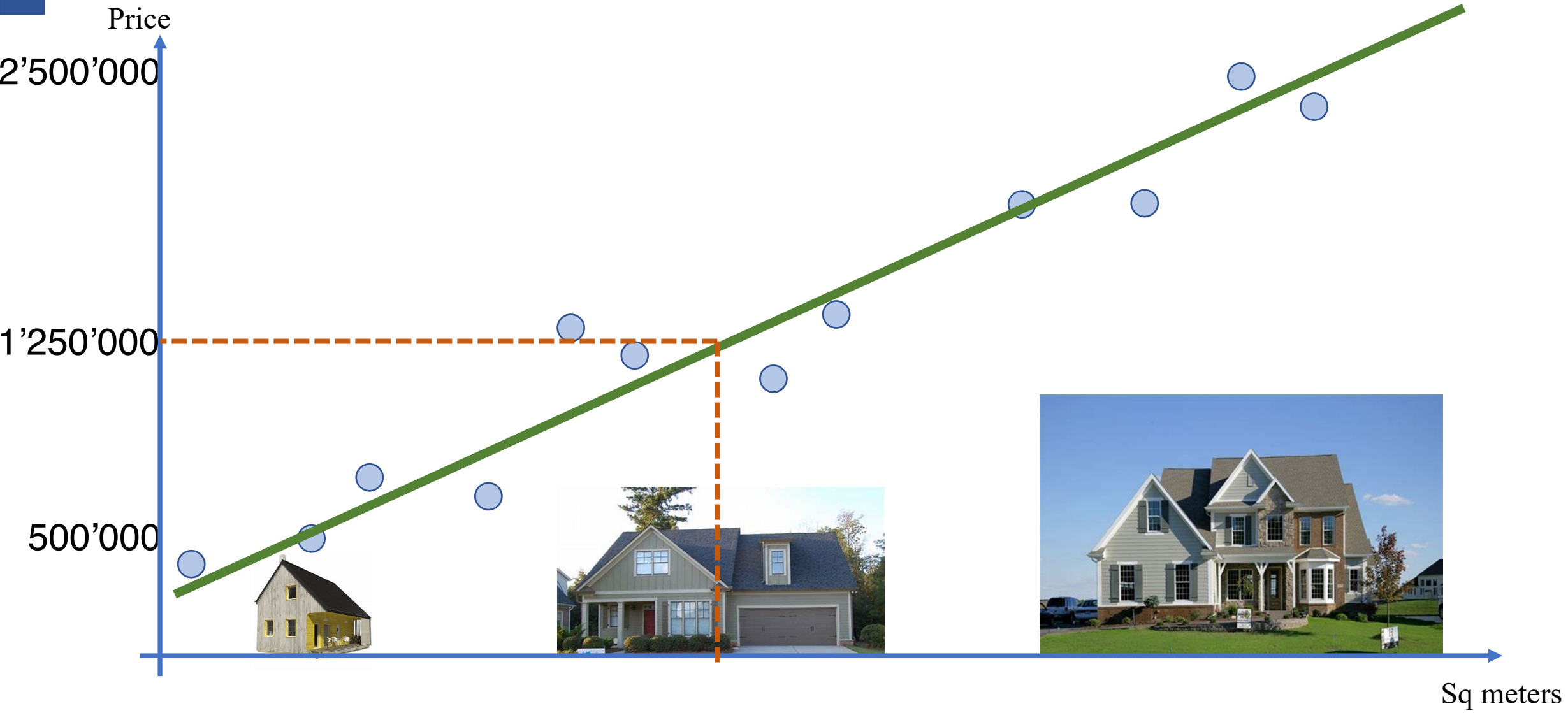
Finding the price of a house



What is the your estimate for the new house?

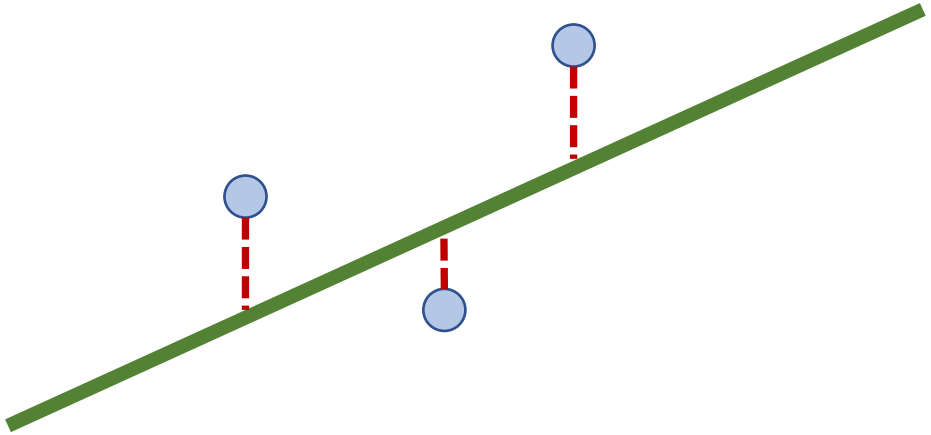
- ☐ 400’000
- ☐ 2’000’000
- ☐ 1’250’000

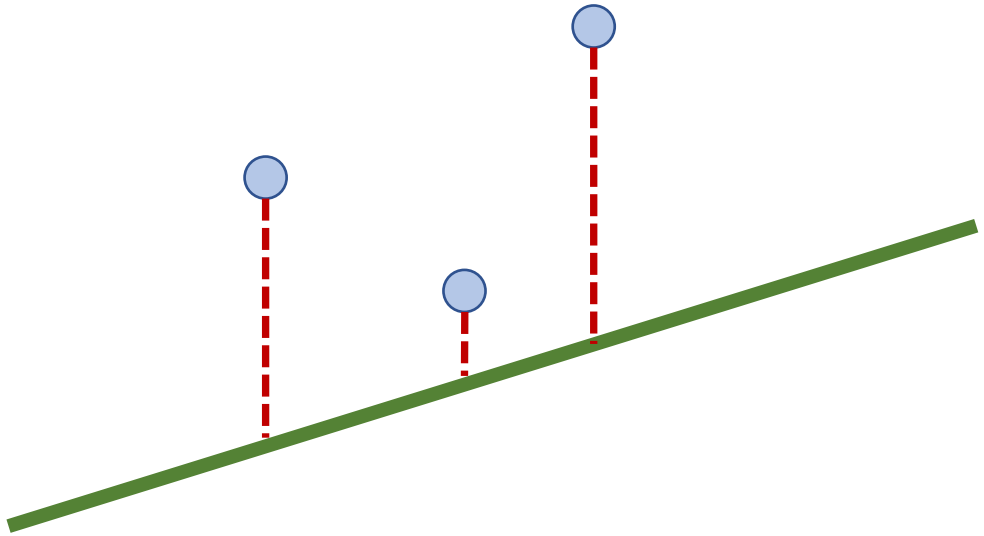
Finding the price of a house



How do we find this best line?

- We try different lines and keep the one that minimizes some cost function.





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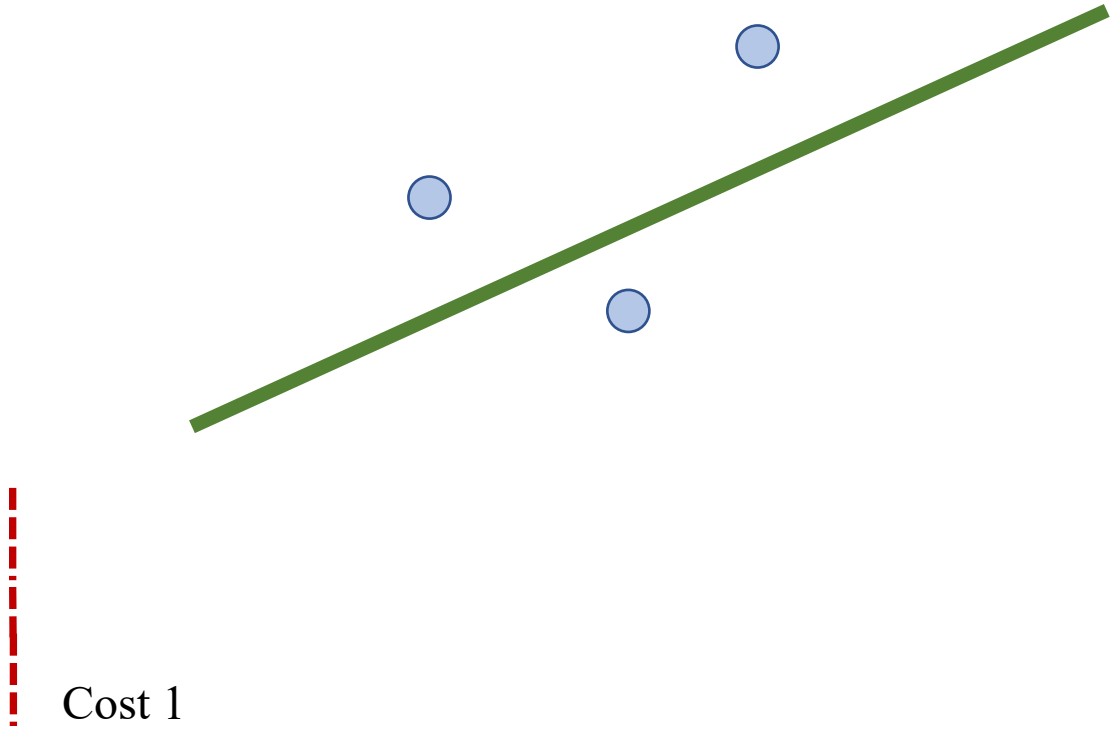
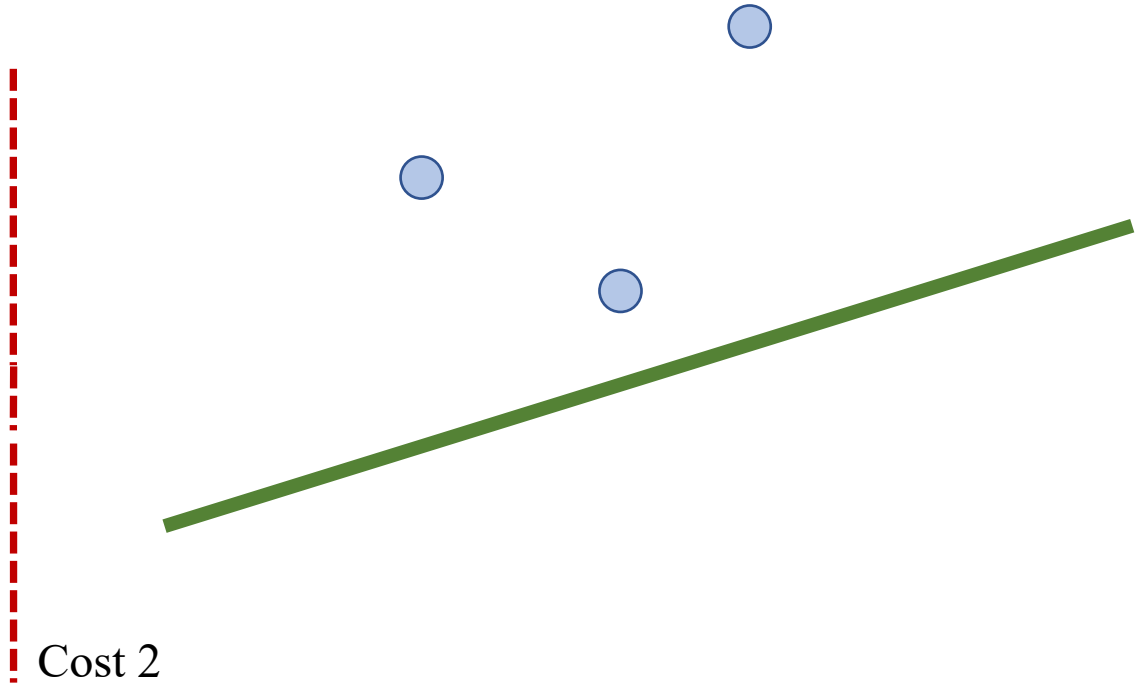




How do we find this best line?

- We don’t just try them randomly.
- We use an approach called “gradient descent” that steers the line towards the most promising directions.

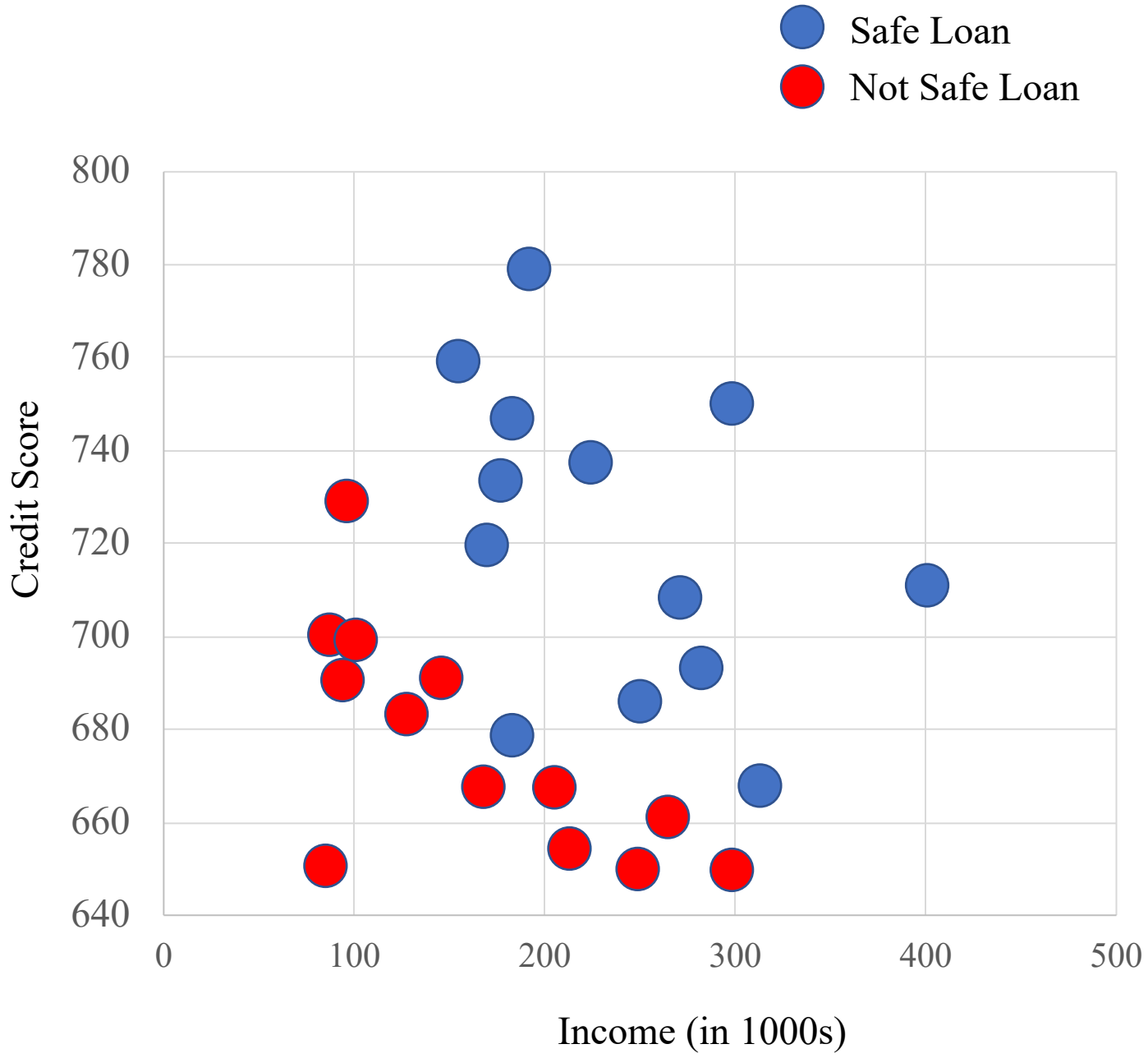
Do you want to predict a quantity?
This is **regression**.

Give a loan or not?

Your company a bank gives you data of past clients in the form:

(credit score, income)
→ Safe Loan or Not Safe

Can you use such data to find if a new customer should be given a loan or not?



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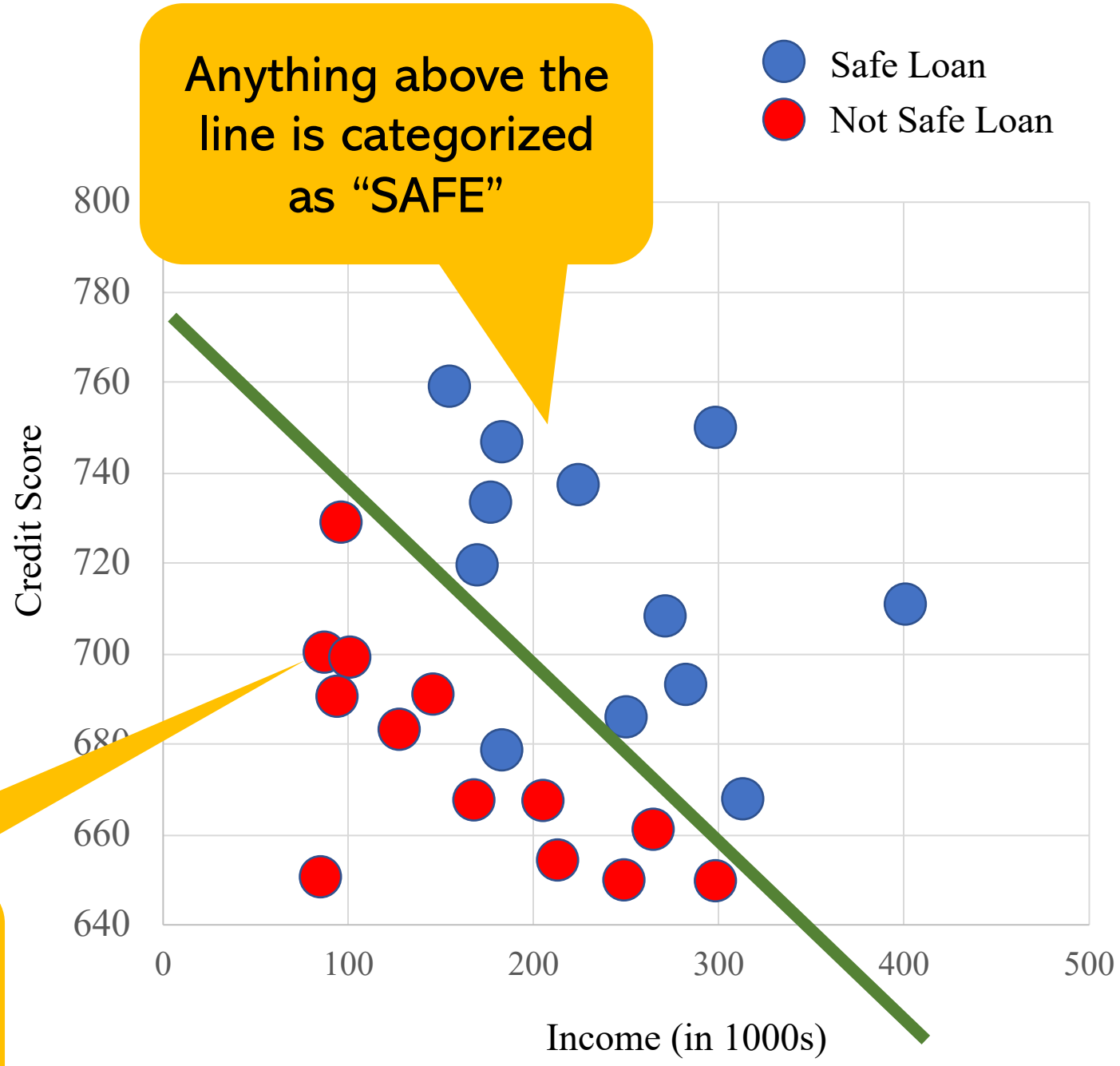

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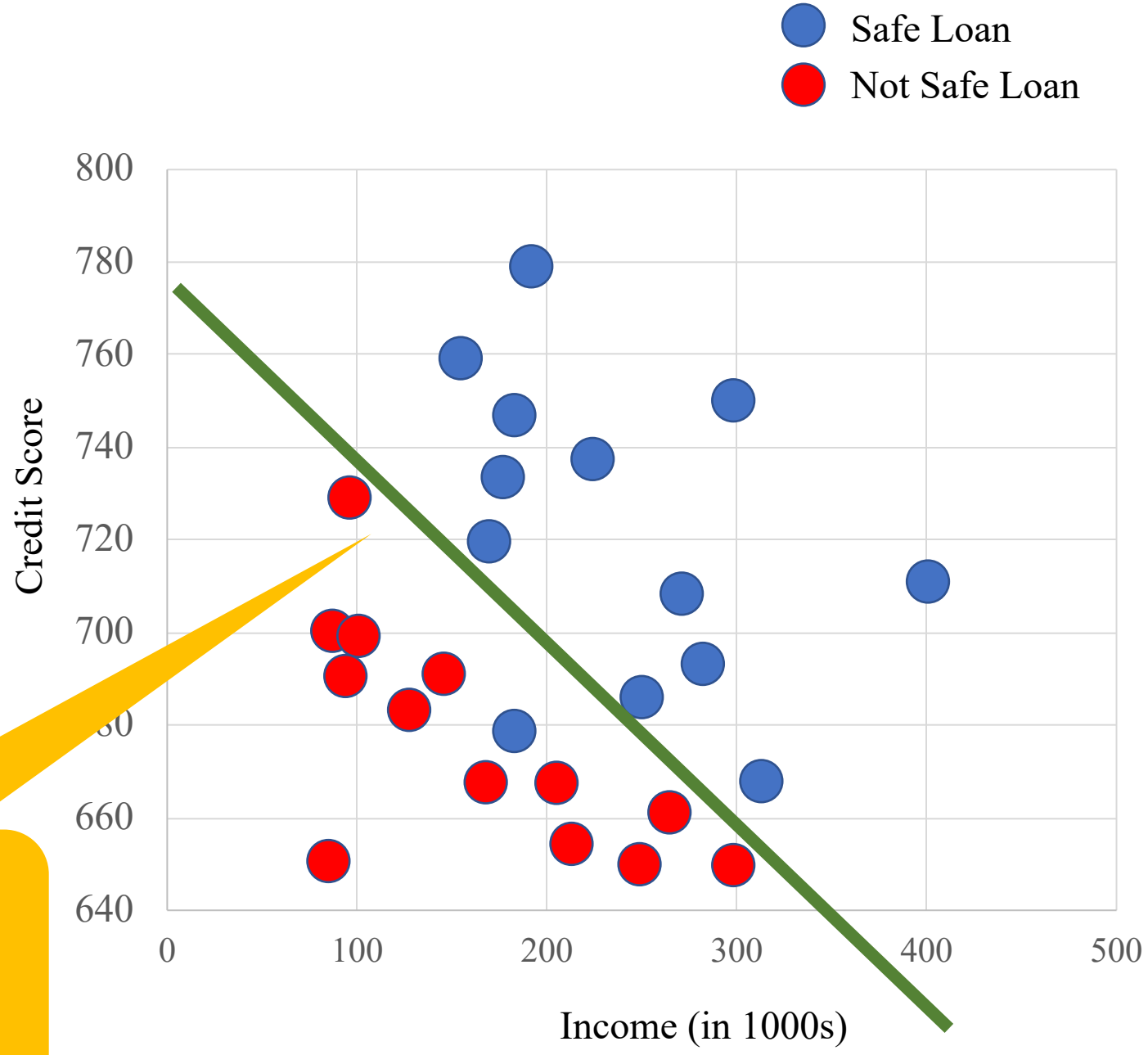
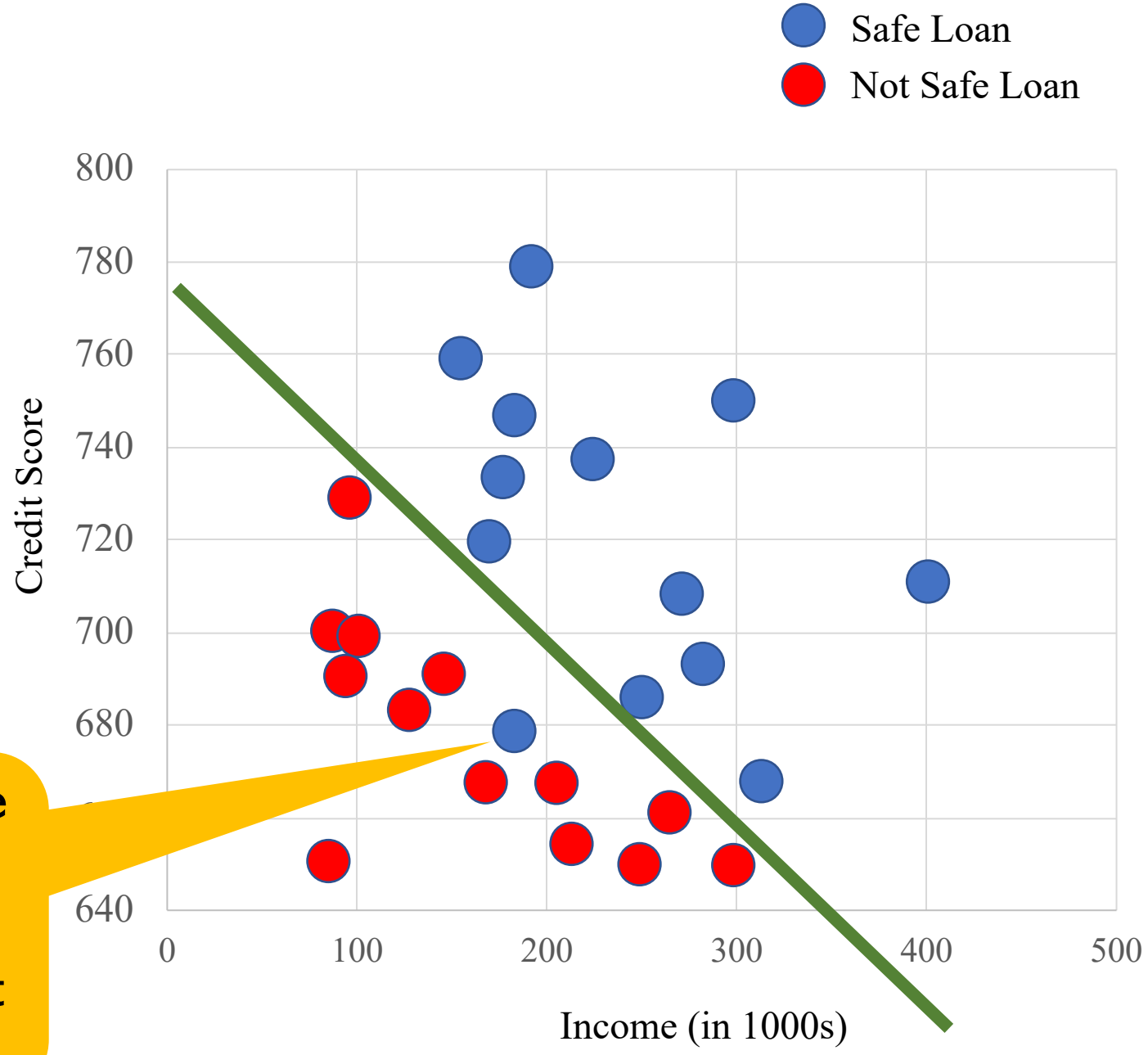


This is an example of a "Logistic Regression"

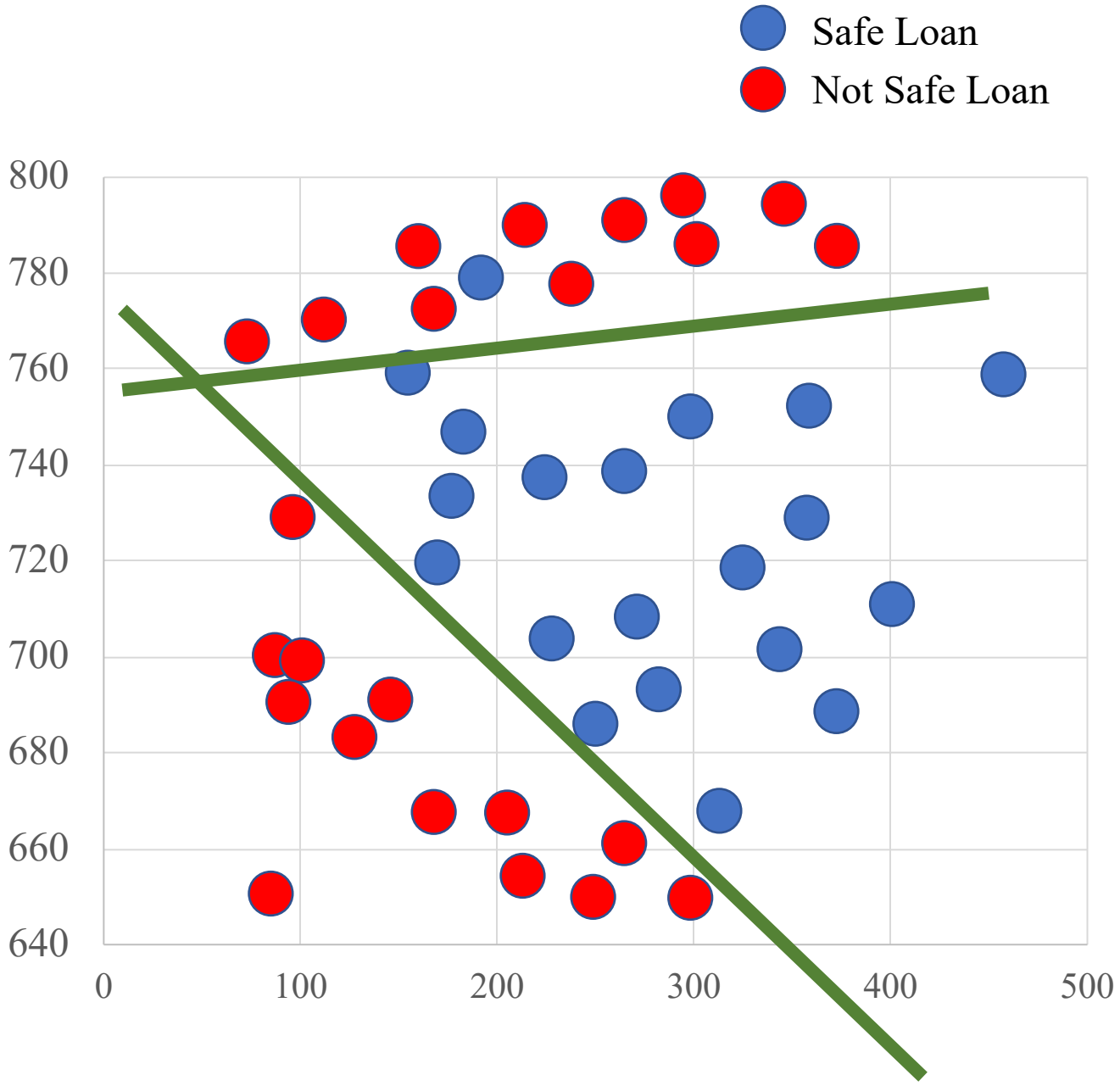
Give a loan or not?



You may have some "misclassifications" or errors. The goal is to find a line that has a fewest errors.

Neural Networks

If we combine many of these functions, then we can solve more complex categorization problems, like the one on the right.



Do you want to predict a category (something discrete)?
That's **classification.**

I recently received
this email
in my inbox.

Because I logged in to my account from a location I haven't previously.

Microsoft account unusual sign-in activity Inbox ×

Microsoft account team <account-security-noreply@accountprotection.microsoft.com>
to me

Microsoft account

Unusual sign-in activity

We detected something unusual about a recent sign-in to the Microsoft account mi*****@outlook.com.

Sign-in details

Country/region: Macao SAR

IP address: 202.175.165.98

Date: 3/11/2019 2:57 PM (CET)

Platform: Mac OS

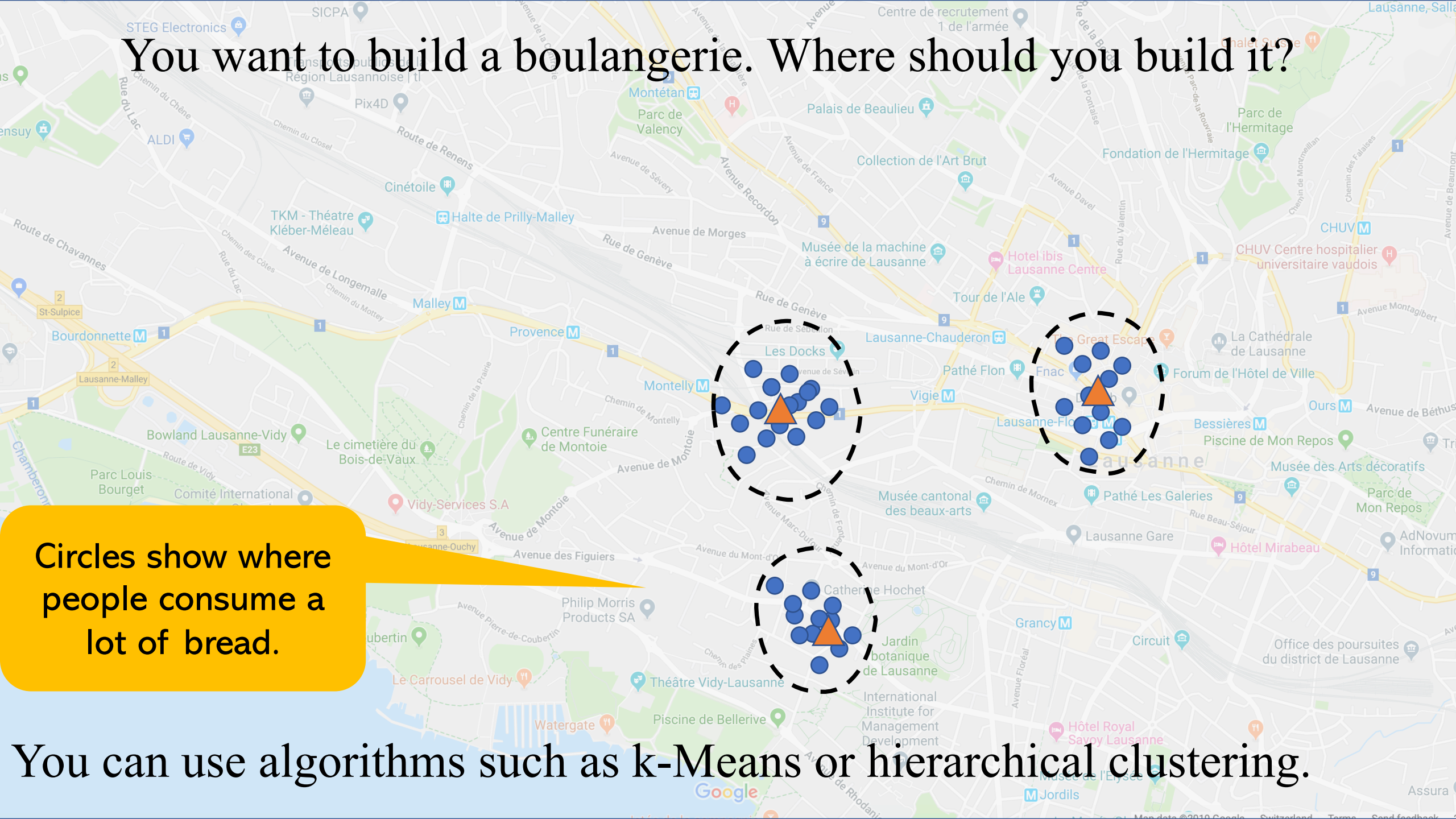
Browser: Safari

Please go to your recent activity page to let us know whether or not this was you. If this wasn't you, we'll help you similar activity in the future.

Review recent activity

Do you want to predict something out of the ordinary? That's **anomaly or outlier detection.**

You want to build a boulangerie. Where should you build it?



You can use algorithms such as k-Means or hierarchical clustering.

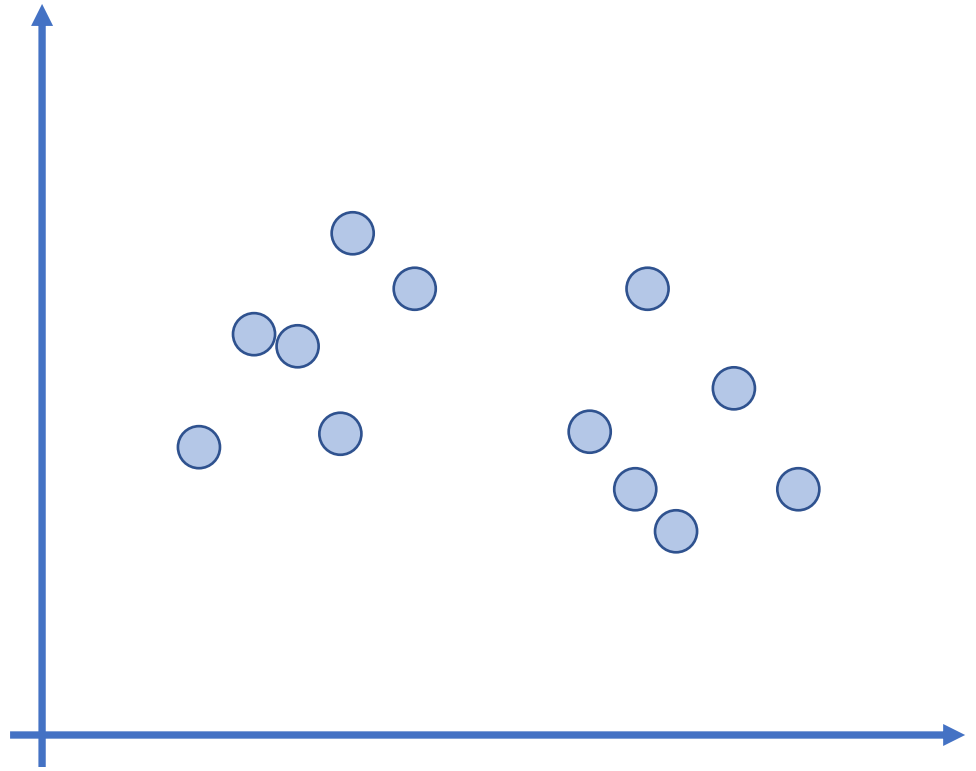
Do you want to discover structure in unexplored (unlabeled) data? That's **clustering.**

Supervised vs Unsupervised Learning

- Find structure in “unlabeled” data
- We are not giving to the algorithm the “right” answer

supervised

unsupervised



Example of unsupervised learning

Google News

Search for topics, locations & sources

- Top stories
- For you
- Favorites
- Saved searches
- U.S.
- World
- Business
- Technology
- Entertainment

Headlines

More Headlines

9 killed in Ohio in second U.S. mass shooting within 24 hours

The Washington Post · 1 hour ago

- **Special Report: Two Mass Shootings In 13 Hours Leave 29 People Dead | NBC News**
  NBC News · 3 hours ago
- **Special Report: Nine people killed in Dayton, Ohio, shooting**
  CBS News · 4 hours ago
- **Governor DeWine orders flags at half mast following mass shooting in Dayton**
  WJW FOX 8 News Cleveland · 4 hours ago · **Local coverage**
- **Gov. DeWine orders flags at half-staff for victims of Dayton mass shooting**
  WLWT Cincinnati · 1 hour ago

View full coverage

Example of unsupervised lea

Google News

Search for topics, locations & sources

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- For you
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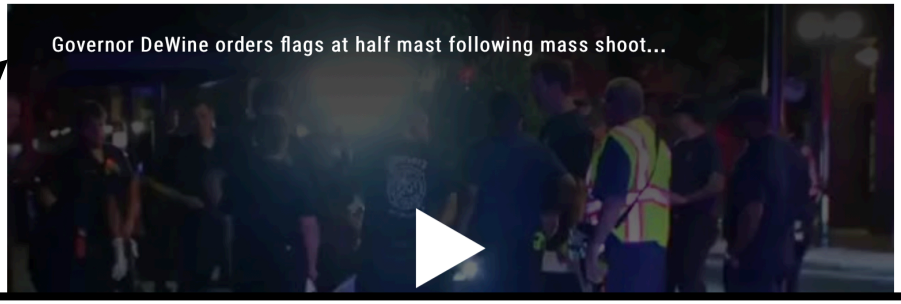
  CBS News · 4 hours ago
- **Governor DeWine orders flags at half mast following mass shooting in Dayton**
  WJW FOX 8 News Cleveland · 4 hours ago · Local coverage
- **Gov. DeWine orders flags at half-staff for victims of Dayton mass shooting**
  WLWT Cincinnati · 1 hour ago

View full coverage

Governor DeWine orders flags at half mass shooting in Dayton

POSTED 6:55 AM, AUGUST 4, 2019, BY TALIA NAQUIN, *UPDATED AT 11:03AM, AUGUST 4, 2019*

FACEBOOK TWITTER PINTEREST



YouTube CH

Search


QUIZ
Time

In-Class Exercise

7 mins

Find at least two more examples of a data analytics success story or a startup in the field of data mining/machine learning/data science

- Business Model: How do they make money?
- What do they do? What is special/innovative?

The Data & the Model

Typical data you should expect

	customerID	gender	SeniorCitizen	Partner	Dependents	tenure	PhoneService	OnlineSecurity	...	TotalCharges	Churn
0	7590-VHVEG	Female	0	Yes	No	1	No	No	...	29.85	No
1	5575-GNVDE	Male	0	No	No	34	Yes	Yes	...	1889.5	No
2	3668-QPYBK	Male	0	No	No	2	Yes	Yes	...	108.15	Yes
3	7795-CFOCW	Male	0	No	No	45	No	Yes	...	1840.75	No
4	9237-HQITU	Female	0	No	No	2	Yes	No	...	151.65	Yes

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4	9237-HQITU	Female	0	No	No	2		No	...	151.65	Yes

or “training example”

Observation = one row

Typical data you should expect

	customerID	gender	SeniorCitizen	Partner	Dependents	tenure	PhoneService	OnlineSecurity	...	TotalCharges	Churn
0	7590-VHVEG	Female	0	Yes	No	1	No	No	...	29.85	No
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4	9237-HQITU	Female	0	No		2	Yes	No	...	151.65	Yes

Feature x = column
(independent variables or predictors)

Typical data you should expect

	customerID	gender	SeniorCitizen	Partner	Dependents	tenure	PhoneService	OnlineSecurity	...	TotalCharges	Churn
0	7590-VHVEG	Female	0	Yes	No	1	No	No	...	29.85	No
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4	9237-HQITU	Female	0	No		2	Yes	No	...	151.65	Yes

All the features → X

Typical data you should expect

	customerID	gender	SeniorCitizen	Partner	Dependents	tenure	PhoneService	OnlineSecurity	...	TotalCharges	Churn
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4	9237-HQITU	Female	0	No	No	2	Yes	No	...	151.65	Yes

"High-dimensional data" = lots of columns

Number of all features = data dimensionality

Typical data you should expect

	customerID	gender	SeniorCitizen	Partner	Dependents	tenure	PhoneService	OnlineSecurity	...	TotalCharges	Churn
0	7590-VHVEG	Female	0	Yes	No	1	No	No	...	29.85	No
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Target variable
(dependent variable)

Regression problem

Typical data you should expect

	customerID	gender	SeniorCitizen	Partner	Dependents	tenure	PhoneService	OnlineSecurity	...	TotalCharges	Churn
0	7590-VHVEG	Female	0	Yes	No	1	No	No	...	29.85	No
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Classification problem

Target variable y,
dependent variable

Our goal is to build a **model** to answer the business question

Build a model = Learn a function ***f*** that given **X,** and **y**

$$(\text{predicted y}) = f(\text{X})$$

In Regression: y will give real values

In Classification: y will give 0,1 (..2, 3)

The function ***f*** can also be seen as a **set of rules**.

So, a model is nothing more than a set of rules, or a set of mathematical functions.

Types of data mining tasks

Unsupervised
Train with X only

- Similarity Matching
  - What other companies are like our best small business customers?
- Dimensionality Reduction
  - Compress/Summarize my data
- Description / Profiling
  - What does "normal behavior" look like?
- Clustering
  - Do my customers form natural groups?

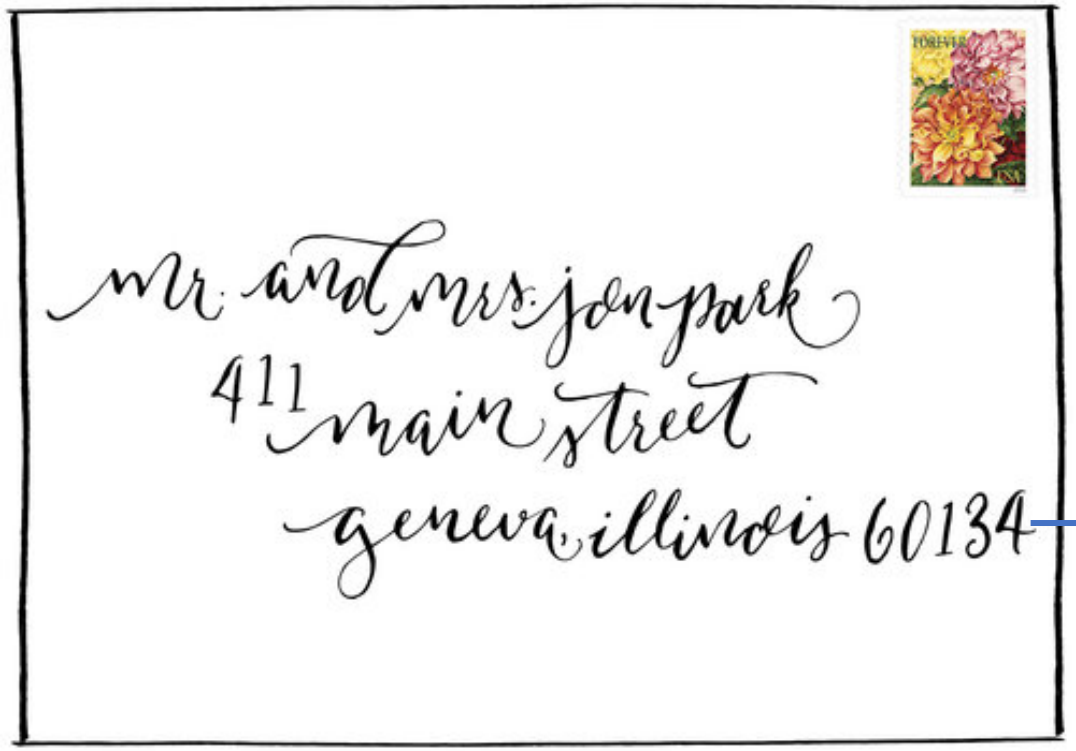
Supervised
Train with (X,y)

- Predictive modelling
  - Will customer *X* churn next month / default on her loan?
  - How much would prospect *X* spend?
  - Will user *X* click on an ad / purchase a product / watch a movie?
  - Who might be good "friends" on our social networking site?
- Regression (continuous output variables)
- Classification (discrete output variables)


QUIZ
Time

Which problem is it?

Identifying the zipcode digits on handwritten envelopes.



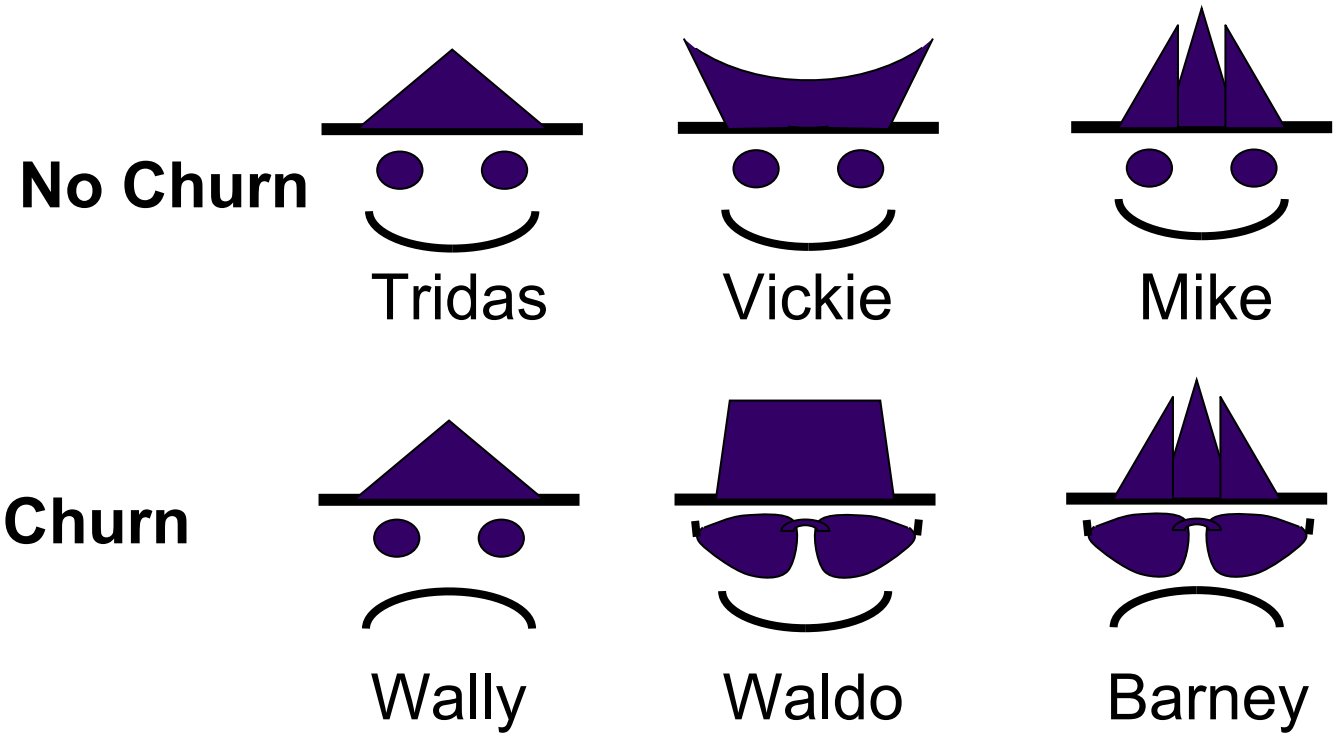
Which problem is it?

Predicting someone’s salary based on years of experience

Which problem is it?

We wish to organize our company's pdf documents in different categories based on document title.

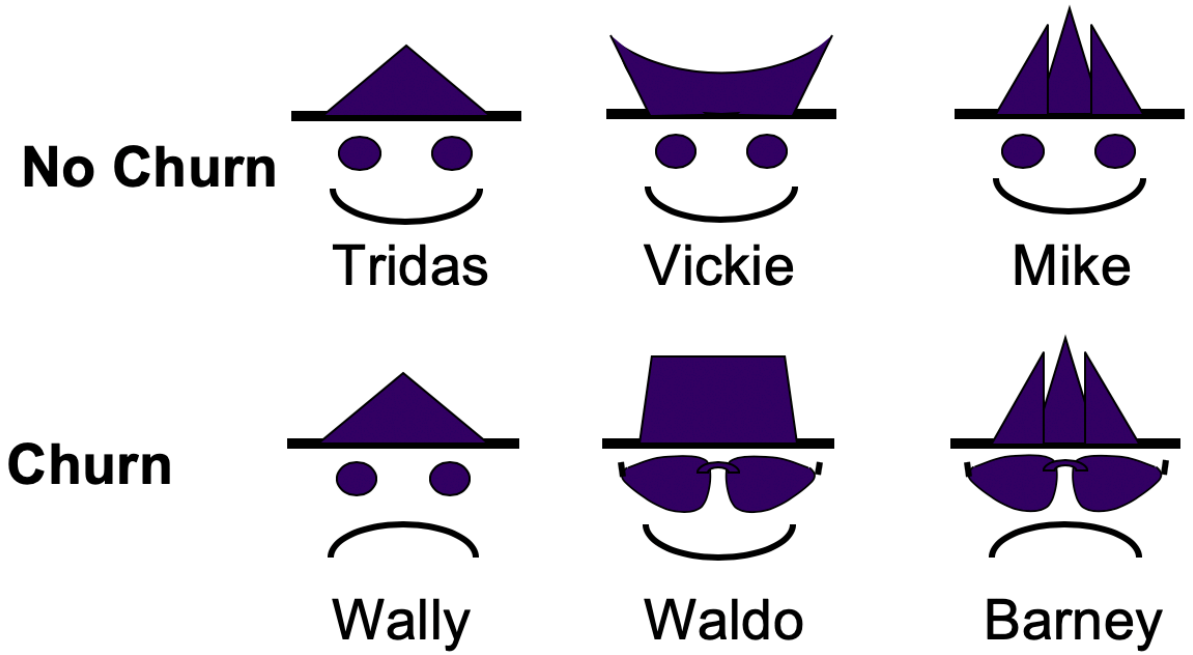
What does it mean to build a model?



What features to use here?

“Manual” Data Mining

What can we learn from the training data?
Are there rules or patterns or features?

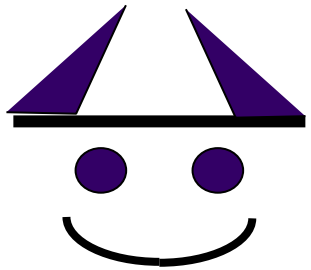


IF “no sun glasses” AND “smile” THEN “no churn”

Using the model/rule for prediction

IF “no sun glasses” AND “smile” THEN “honest”

New example:
Honest or crooked?

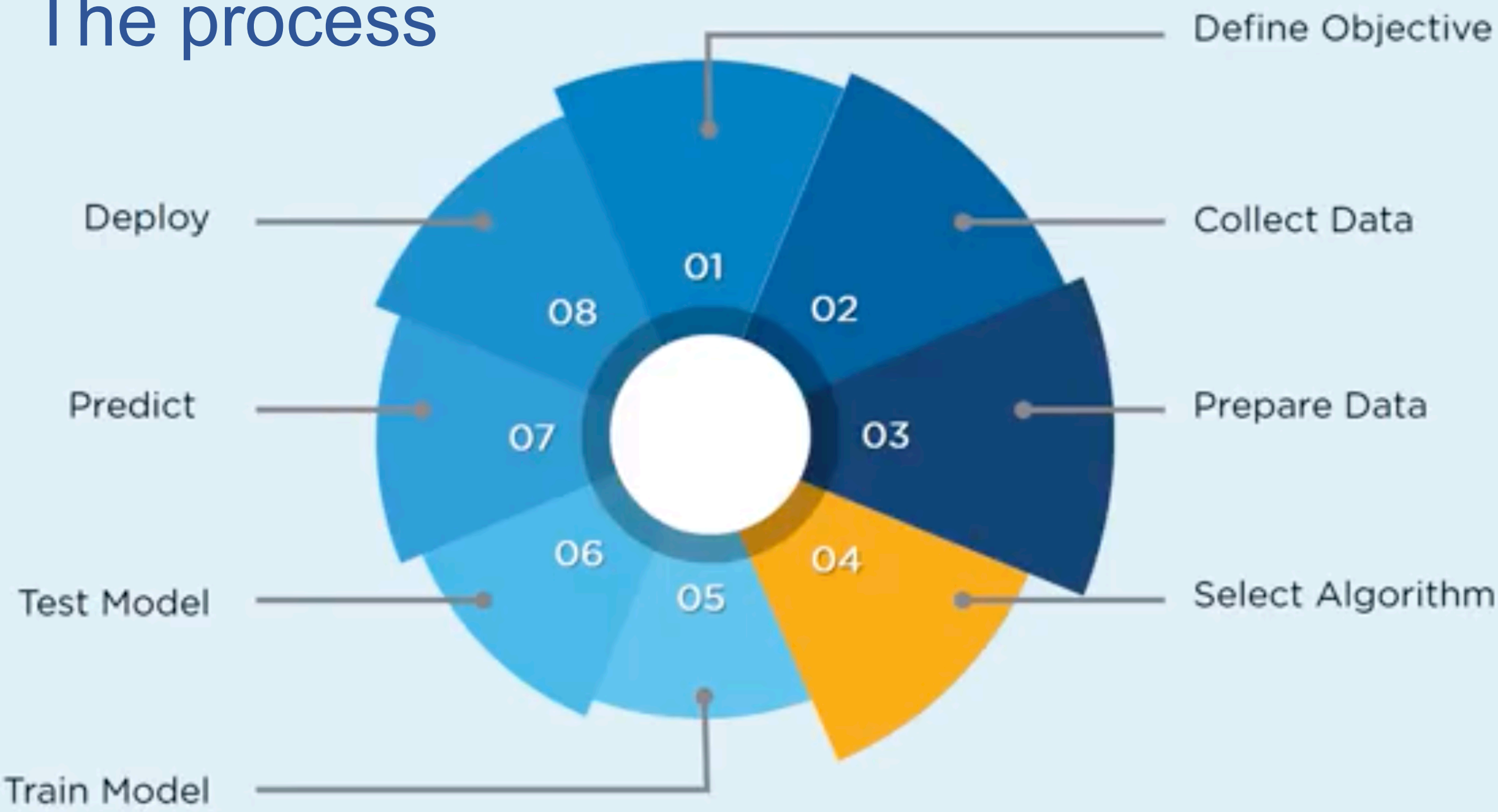


Honest!

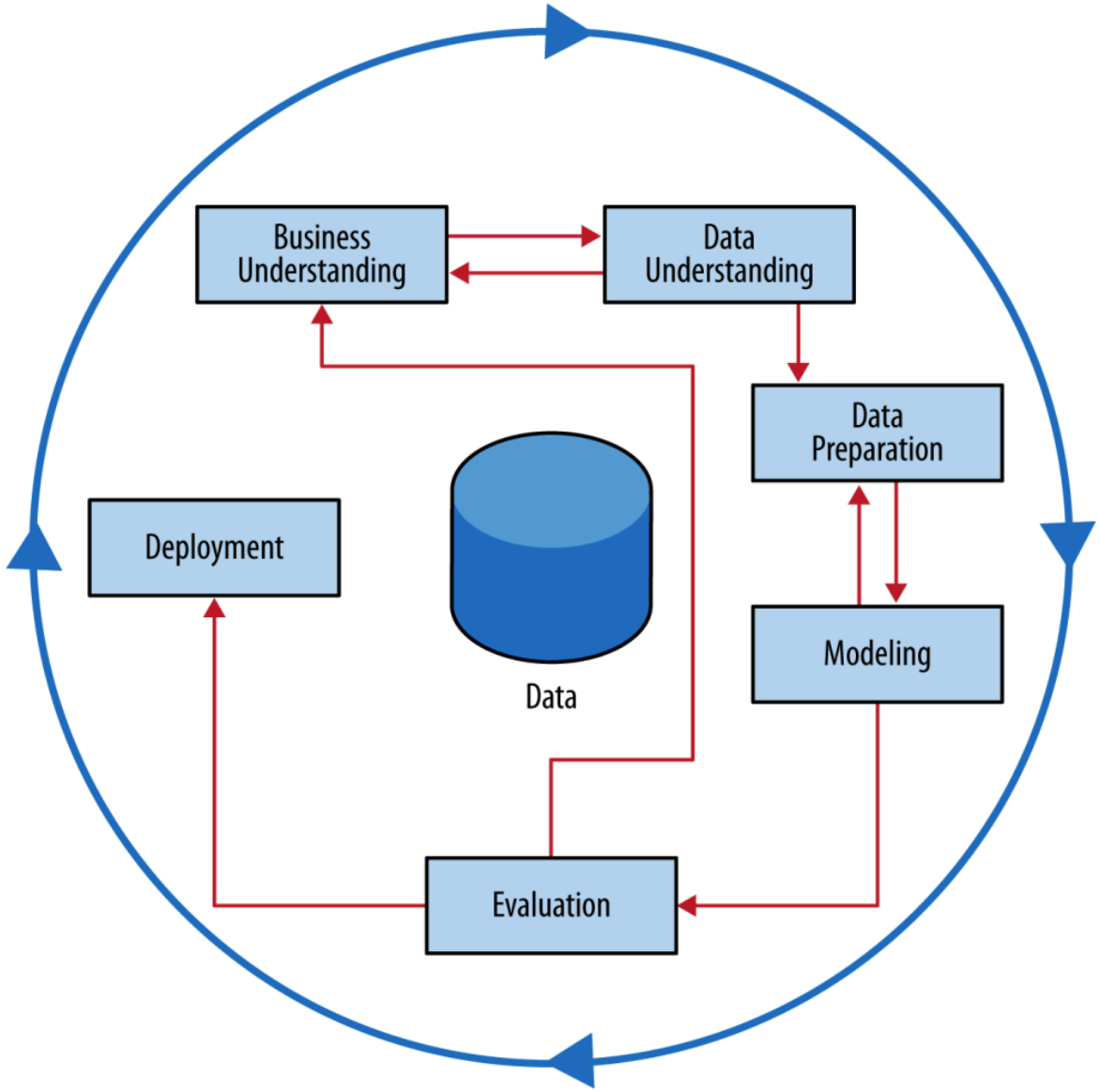
Data Mining Cycle

Overview

The process

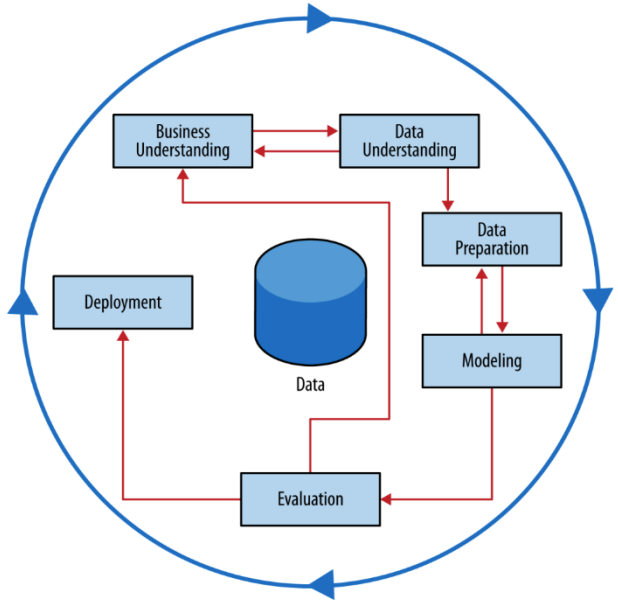

Define Objective
Collect Data
Prepare Data
Select Algorithm
Train Model
Test Model
Predict
Deploy
01
02
03
04
05
06
07
08

Cross-industry standard process for data mining (CRISP-DM)



Source: Provost & Fawcett (2013)

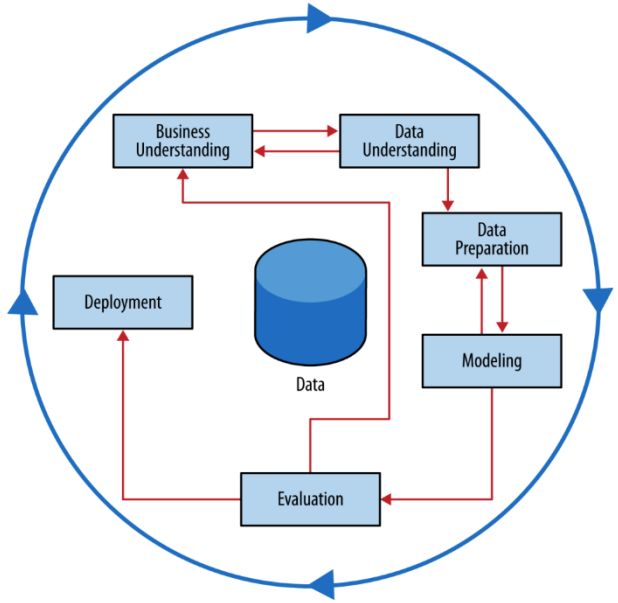
CRISP-DM Steps



Business Understanding

- Define business problem/question
- Restructure business problem as a data mining problem
  - Divide and conquer
    - Recursively split problem into smaller parts and solve them
  - Classification/regression/clustering/…
- Define success criteria
  - Eg. 90% correct classification rate

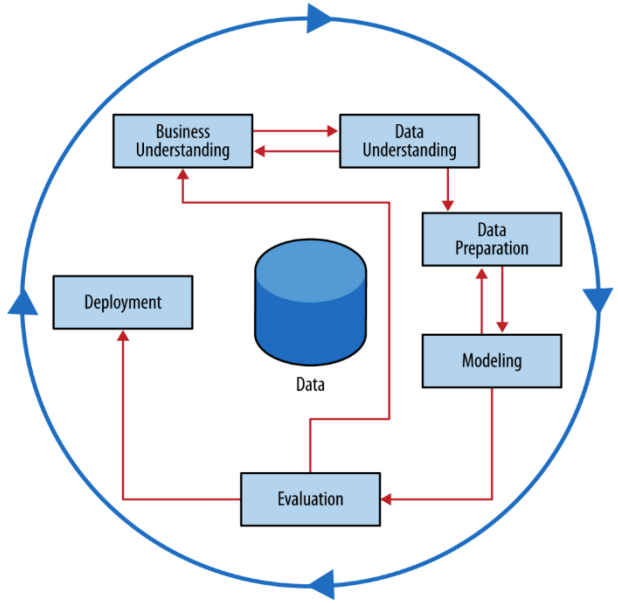
CRISP-DM Steps



Data Understanding

- Collect initial dataset
- Acquire additional data
- Understand data structures
- **Exploratory data analysis** to get first insights
- Assess data quality

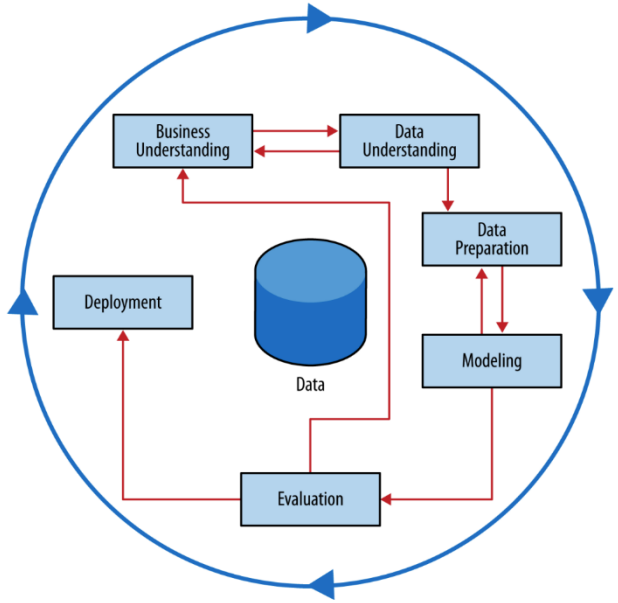
CRISP-DM Steps



Data Preparation

- Clean data
- Construct data
  - new variables
  - new records
  - choose attributes
- Integrate data
- Reformat data

CRISP-DM Steps

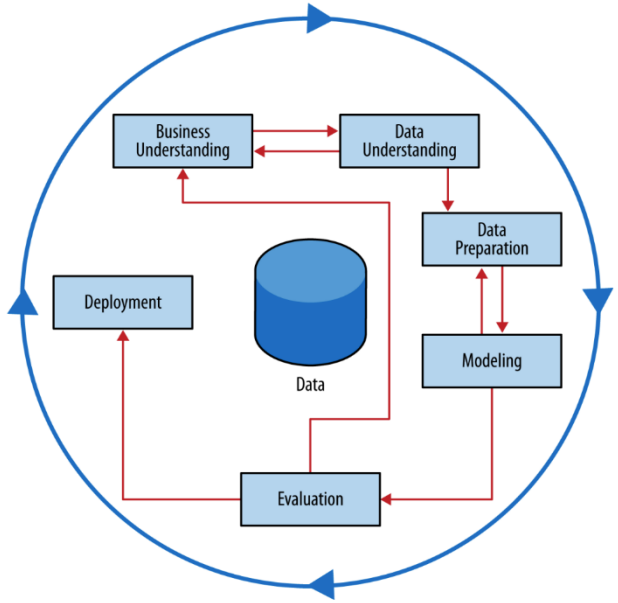


Modeling

- Select algorithms
- Generate training and test sets
- Fit model to data
- Assess model accuracy

- Some techniques have specific requirements on the form of data. Therefore, stepping back to the data preparation phase is often needed.

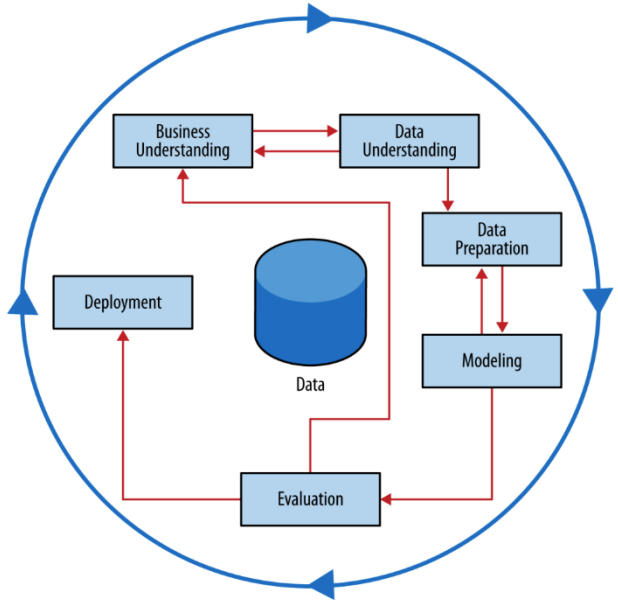
CRISP-DM Steps



Evaluation

- Evaluate data mining results with respect to business goals and success criteria
- Assess legal and ethical considerations
- “In vivo” testing
- “Sign off” from relevant stakeholders

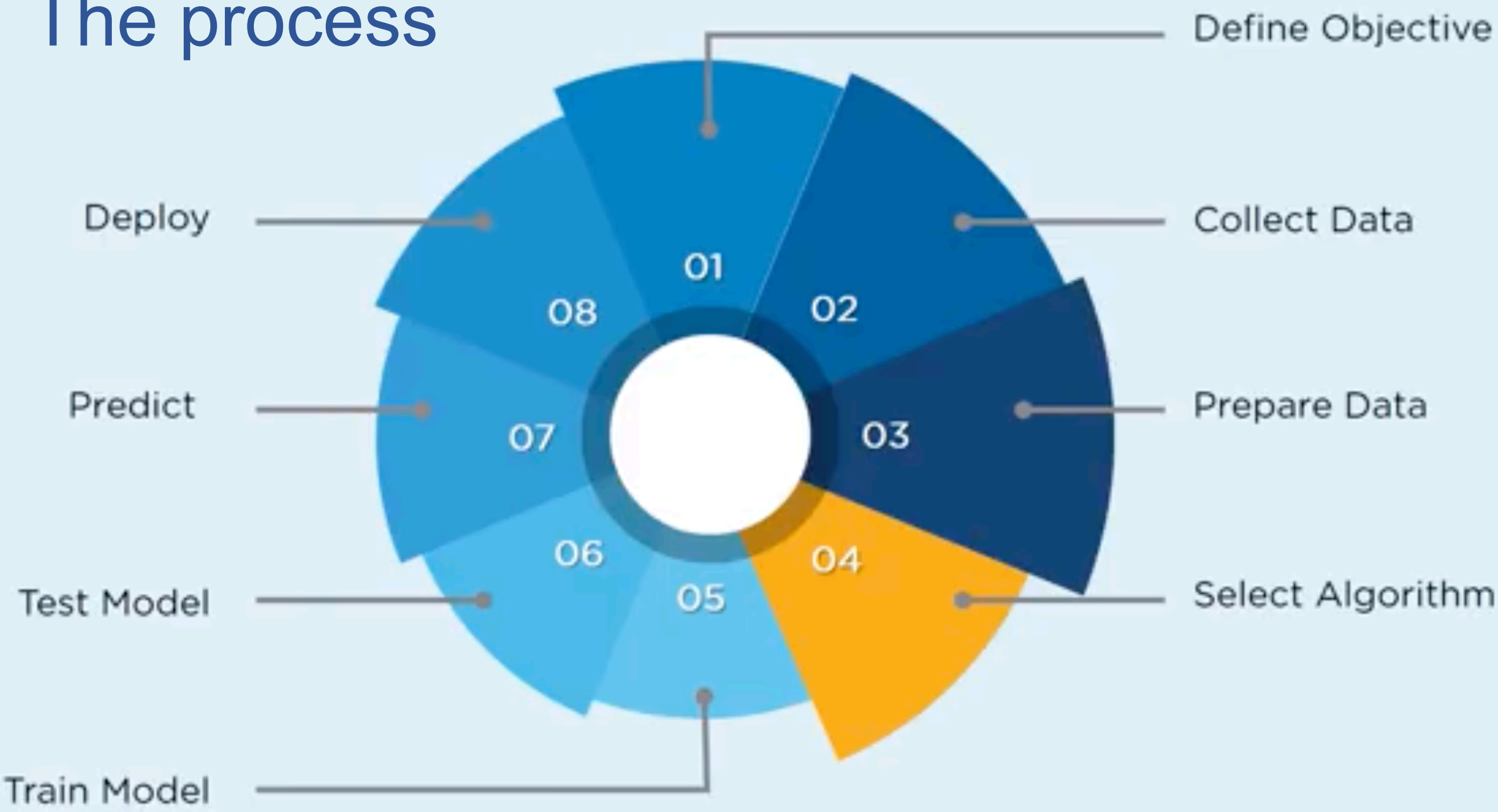
CRISP-DM Steps



Deployment

- Develop production system
- Train employees
- Continuous monitoring and maintenance
- Project review

The process


Define Objective
Collect Data
Prepare Data
Select Algorithm
Train Model
Test Model
Predict
Deploy
01
02
03
04
05
06
07
08

Exploratory Data Analysis

Before we do anything else we start with EDA

	customerID	gender	SeniorCitizen	Partner	Dependents	tenure	PhoneService	OnlineSecurity	...	TotalCharges	Churn
0	7590-VHVEG	Female	0	Yes	No	1	No	No	...	29.85	No
1	5575-GNVDE	Male	0	No	No	34	Yes	Yes	...	1889.5	No
2	3668-QPYBK	Male	0	No	No	2	Yes	Yes	...	108.15	Yes
3	7795-CFOCW	Male	0	No	No	45	No	Yes	...	1840.75	No
4	9237-HQITU	Female	0	No	No	2	Yes	No	...	151.65	Yes

Useful to do some Exploratory Data Analysis (EDA)

- Do you understand what this data is?
- How many rows and columns it has?

About this file

Telcom Customer Churn

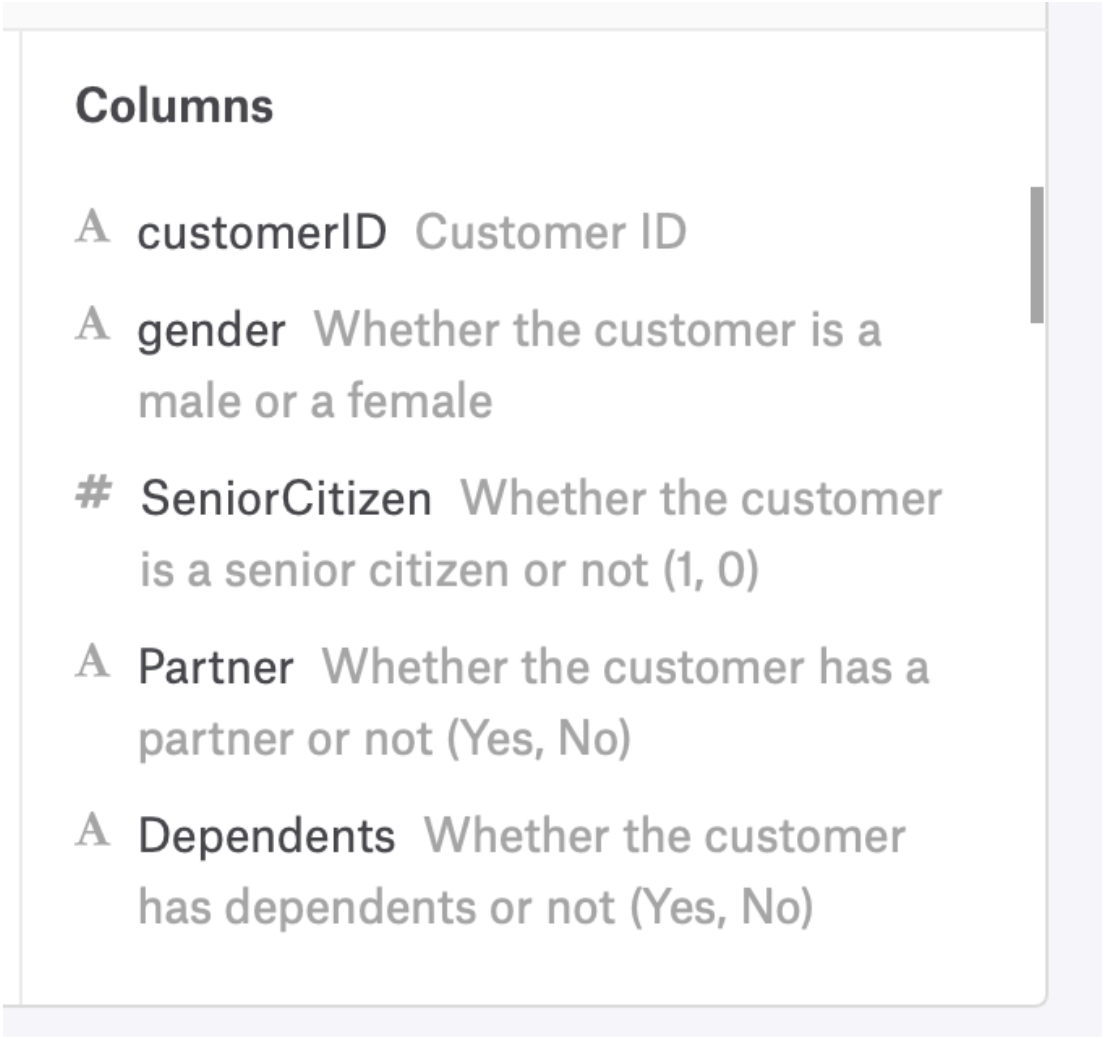
Each row represents a customer, each column contains customer's attributes described on the column Metadata.

The raw data contains 7043 rows (customers) and 21 columns (features).

The "Churn" column is our target.

EDA – what do your columns mean?

- Do you understand what the columns mean?



EDA – do the features have the correct datatype?

- For example, there was a column with dates. Was this properly imported and interpreted as date, or is it just a string?

EDA – do you understand the feature distributions?

gender	SeniorCitizen	Partner	Dependents	tenure	PhoneSer
Whether the customer is a male or a female	Whether the customer is a senior citizen or not (1, 0)	Whether the customer has a partner or not (Yes, No)	Whether the customer has dependents or not (Yes, No)	Number of months the customer has stayed with the company	Whether the has a phone (Yes, No)
Male 50%		No 52%	No 70%		Yes
Female 50%	0 1	Yes 48%	Yes 30%	0 72	No
Other (1) 0%		Other (1) 0%	Other (1) 0%		Other (1)

https://www.kaggle.com/blastchar/telco-customer-churn

EDA

- All the previous steps should help you understand whether the data need some “cleaning”, but for now we will assume that the data have all the values needed and they are correct

- In your class project, expect a big part of your effort to be allocated to the data cleaning and sanitization.

Week 1 Goals

Terminology, Identify the problem

Week 1 Terminology

- Supervised learning vs unsupervised learning
- Regression, Classification, Clustering, Anomaly detection
- What is feature, input variable, output variable, target variable, data dimensionality

Lab1:
Python and Notebooks

Week 1 Lab work

- Install Anaconda, install Spyder (15mins) Hour 1
- Introduction to Python Notebooks (15mins)
- Exercise Notebook (15mins)

- Basic Intro to Python with Pandas (20mins) Hour 2
  - Load a dataset
  - Some basic data analysis
  - Python tutorial: https://docs.python.org/3/ (on your own time)
- Describe Assignment 1 (15mins + questions)
  - Requirements
  - How to do a screen recording.

Question

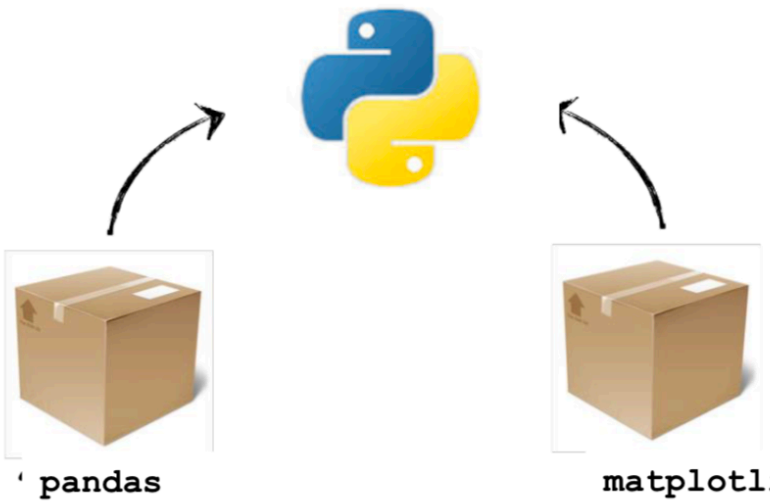
Why should you take a data scientist with you in the jungle?

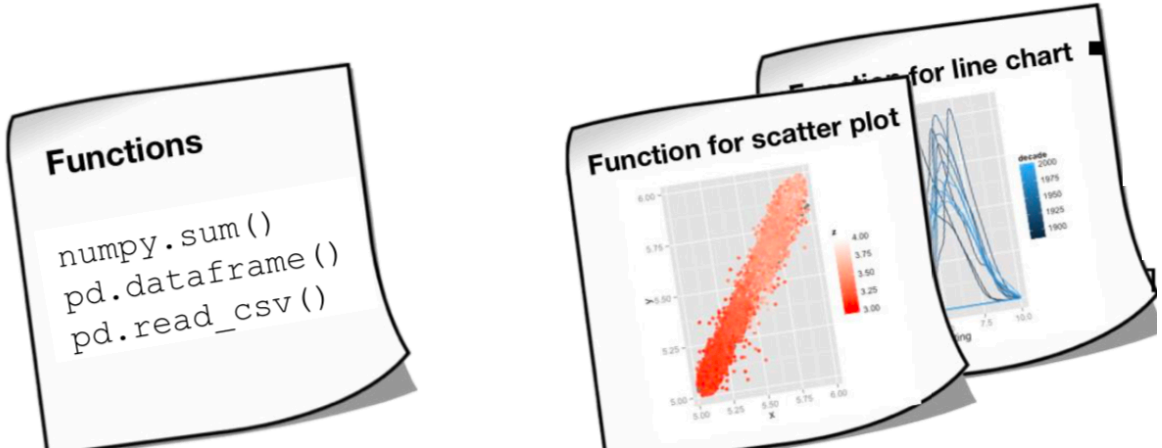
We will be using Python because

- It's **open source** and **free**,
- **simple syntax**; by looking at the code you can understand what it does
- ability to allow **rapid testing** of complex algorithms,
- access to comprehensive **libraries**
- Great **community** support in Stackoverflow

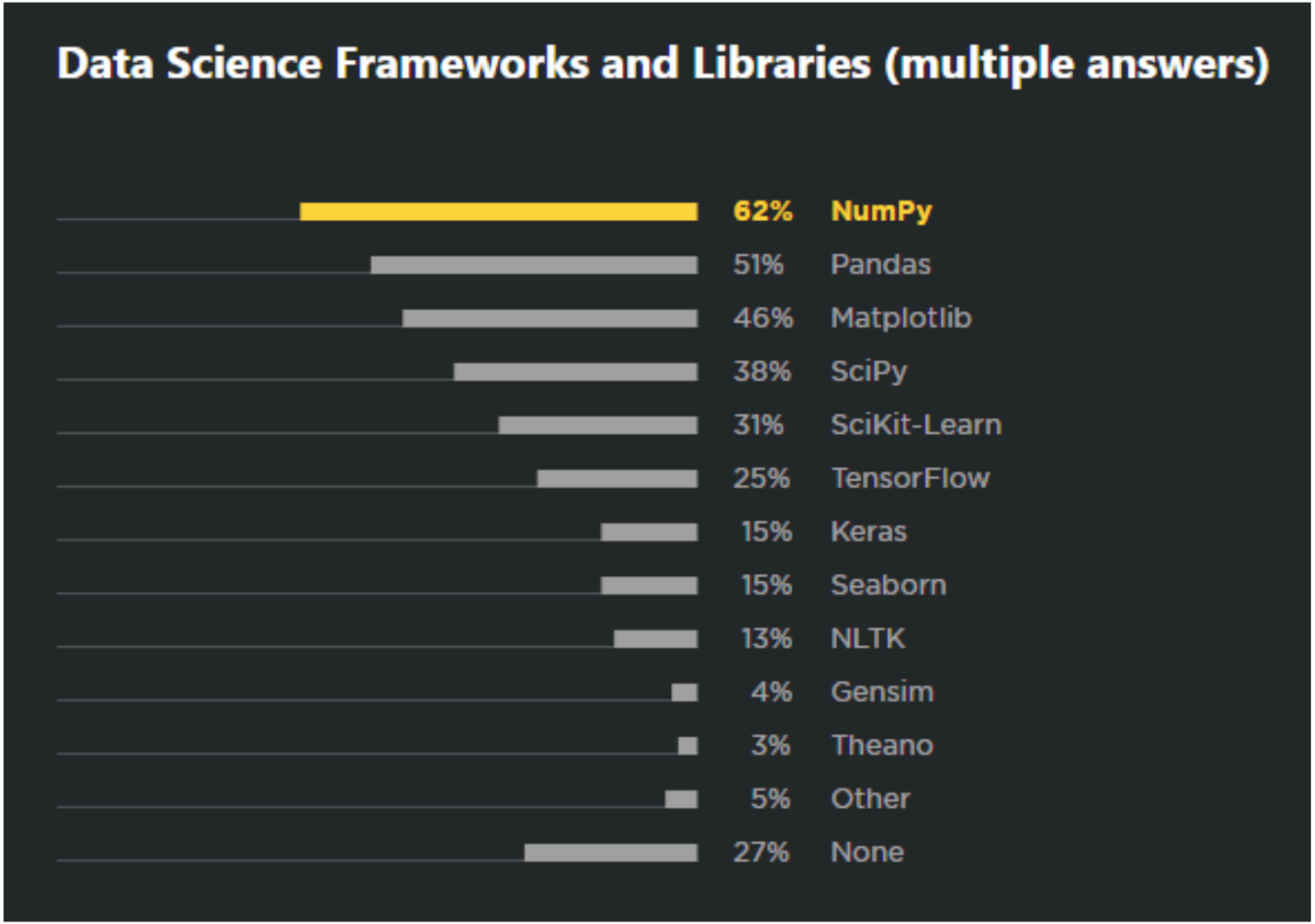
Why is Python so popular?

- Many packages to extend its functionality.





Some popular frameworks in Python. We will cover some of those in the class.

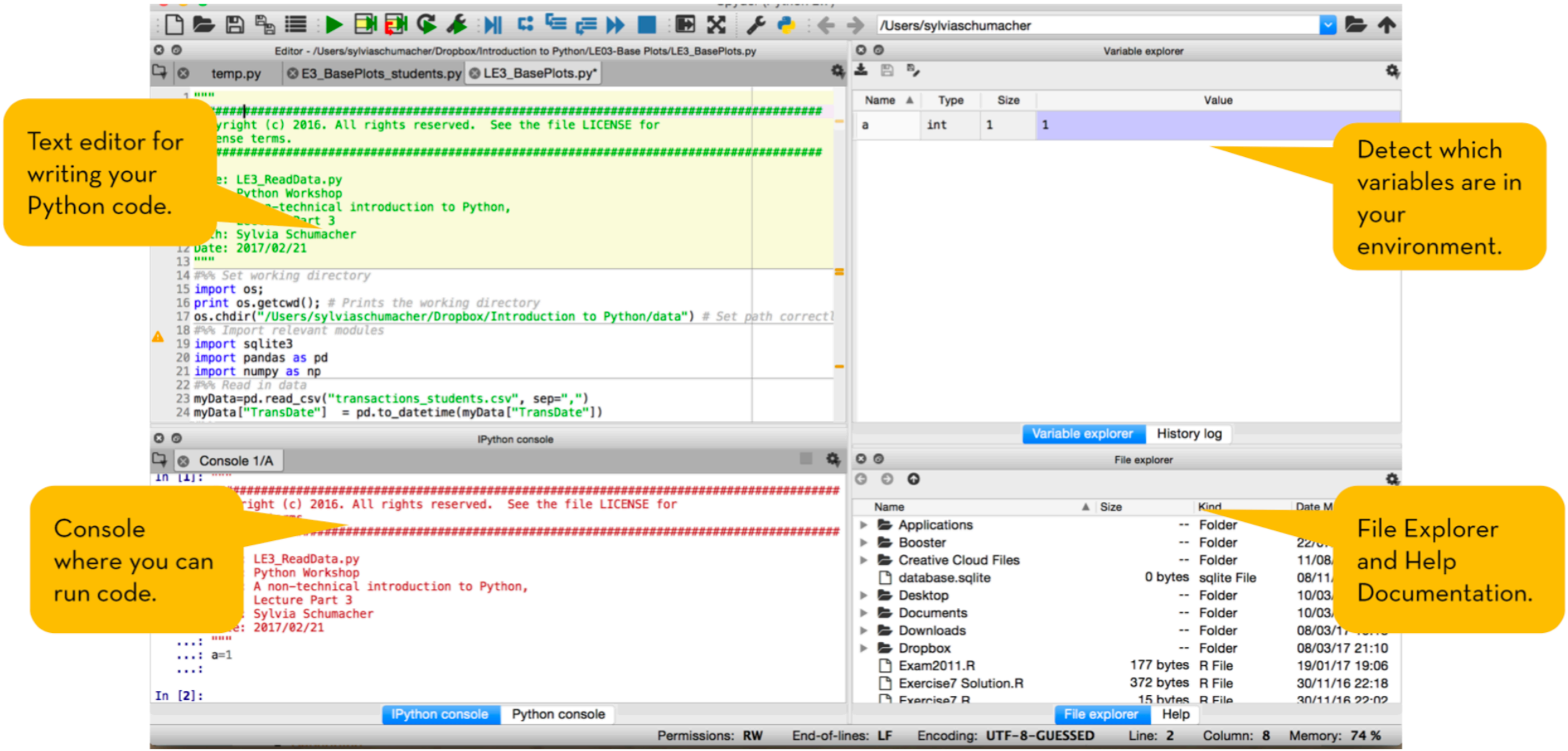


Source: https://www.jetbrains.com/research/python-developers-survey-2018/

What is Spyder?

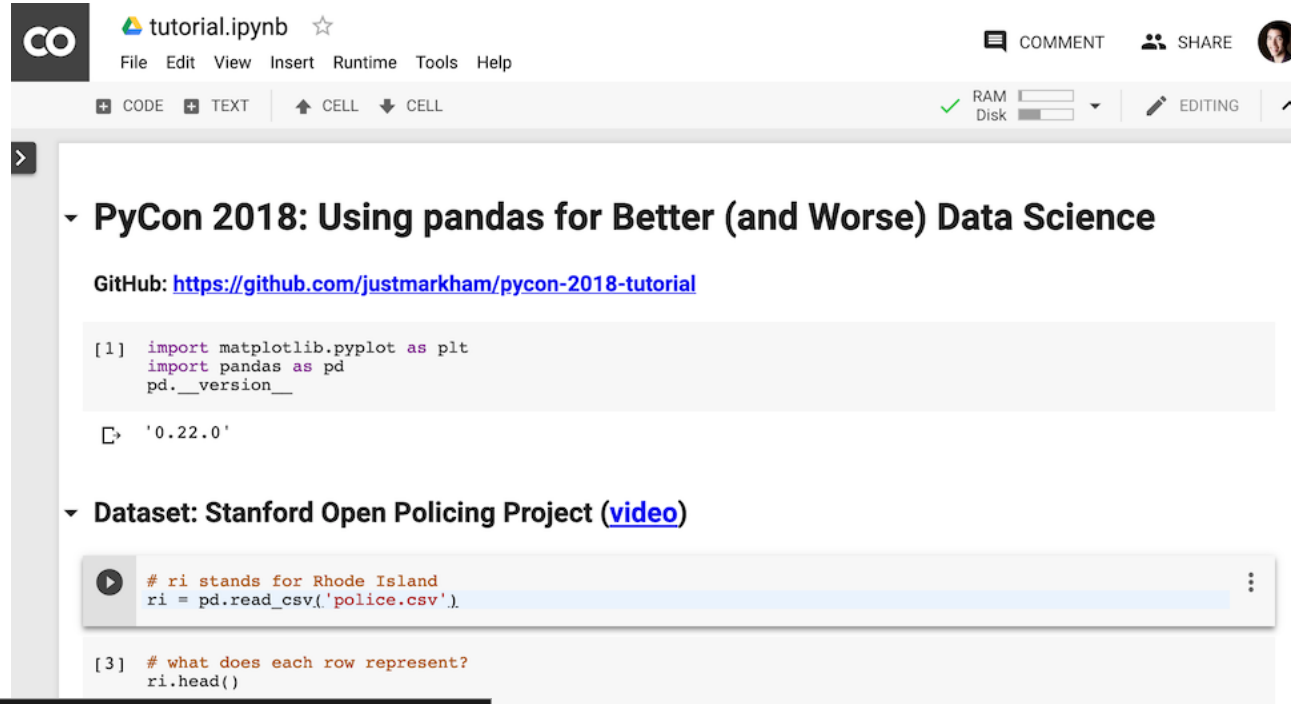
- Spyder is an open-source IDE for Python
- Available for all Operating Systems
- Provides
  - Console
  - Editor
  - Workspace manager

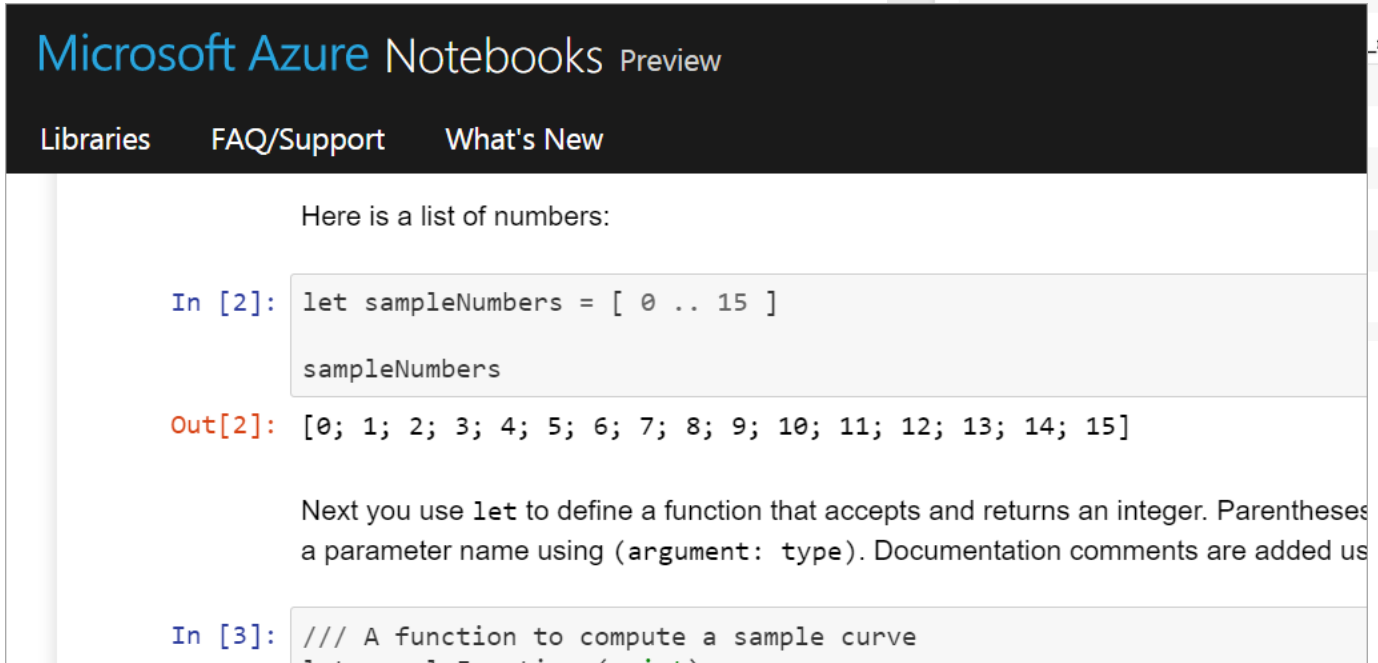
Spyder Interface



Alternative IDE's

- PyCharm
- On the cloud
  - Google Colab (also get GPU time!)
  - Azure Notebooks
  - Jupyter Lab





What is Anaconda?

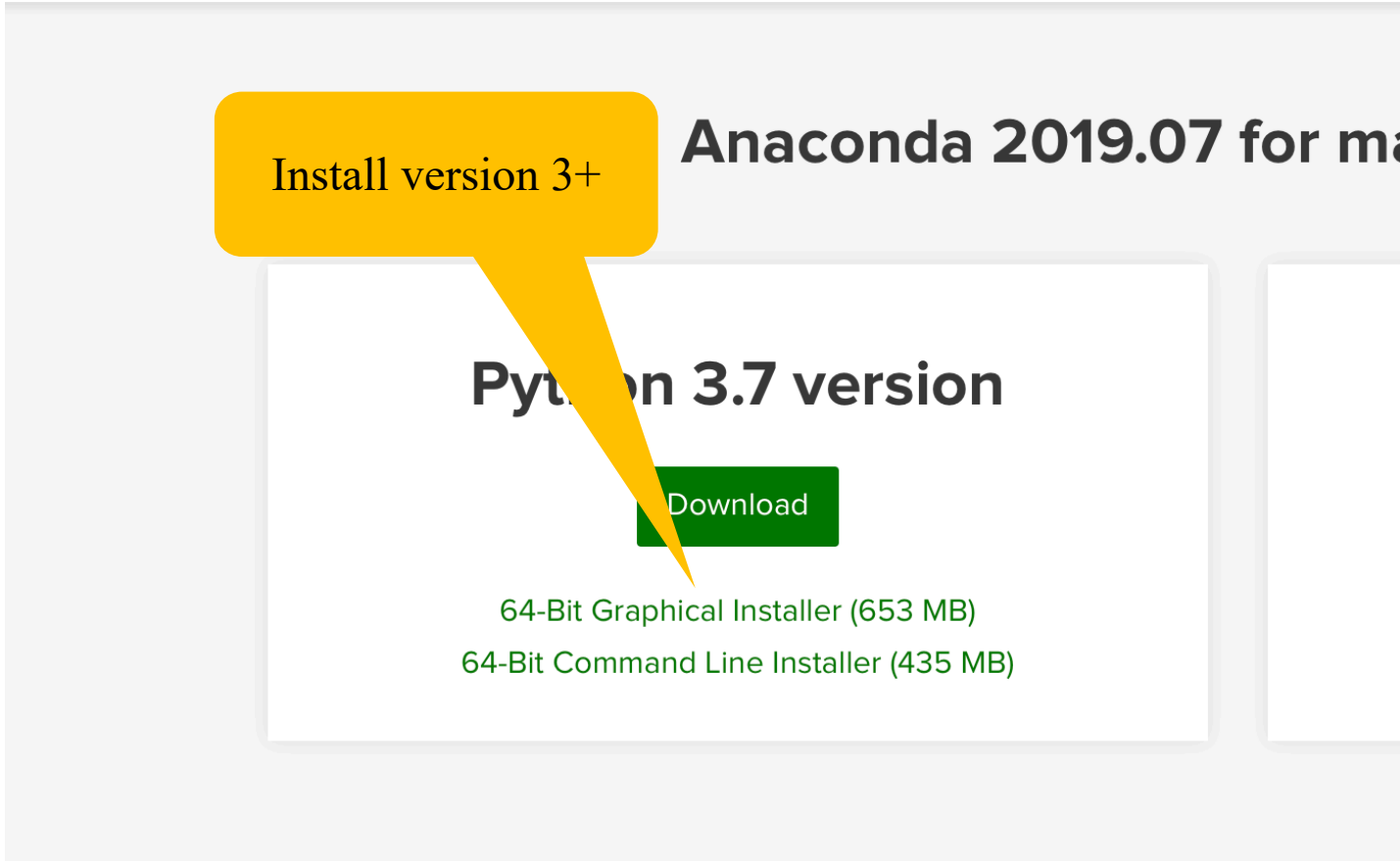
- Anaconda is the leading data science platform powered by Python
- Includes over 100 of the most popular Python, R, Scala packages for data science.
- Part of Anaconda, is conda, a package, dependency and environment manager, which allows the easy installation of >700 important packages.

How to install Anaconda

Go to:

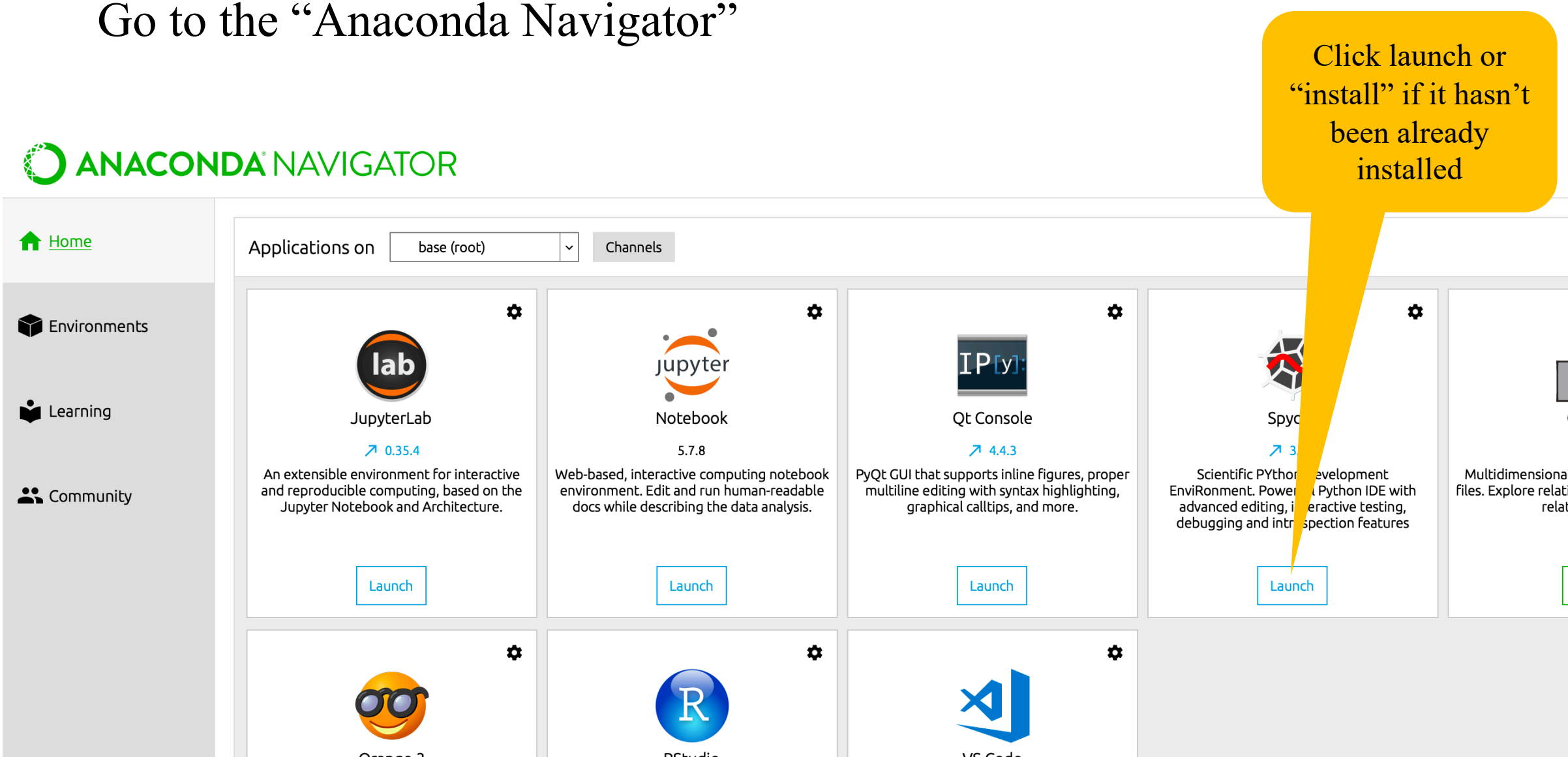
https://www.anaconda.com/distribution/

And download the graphical install for Python version 3+



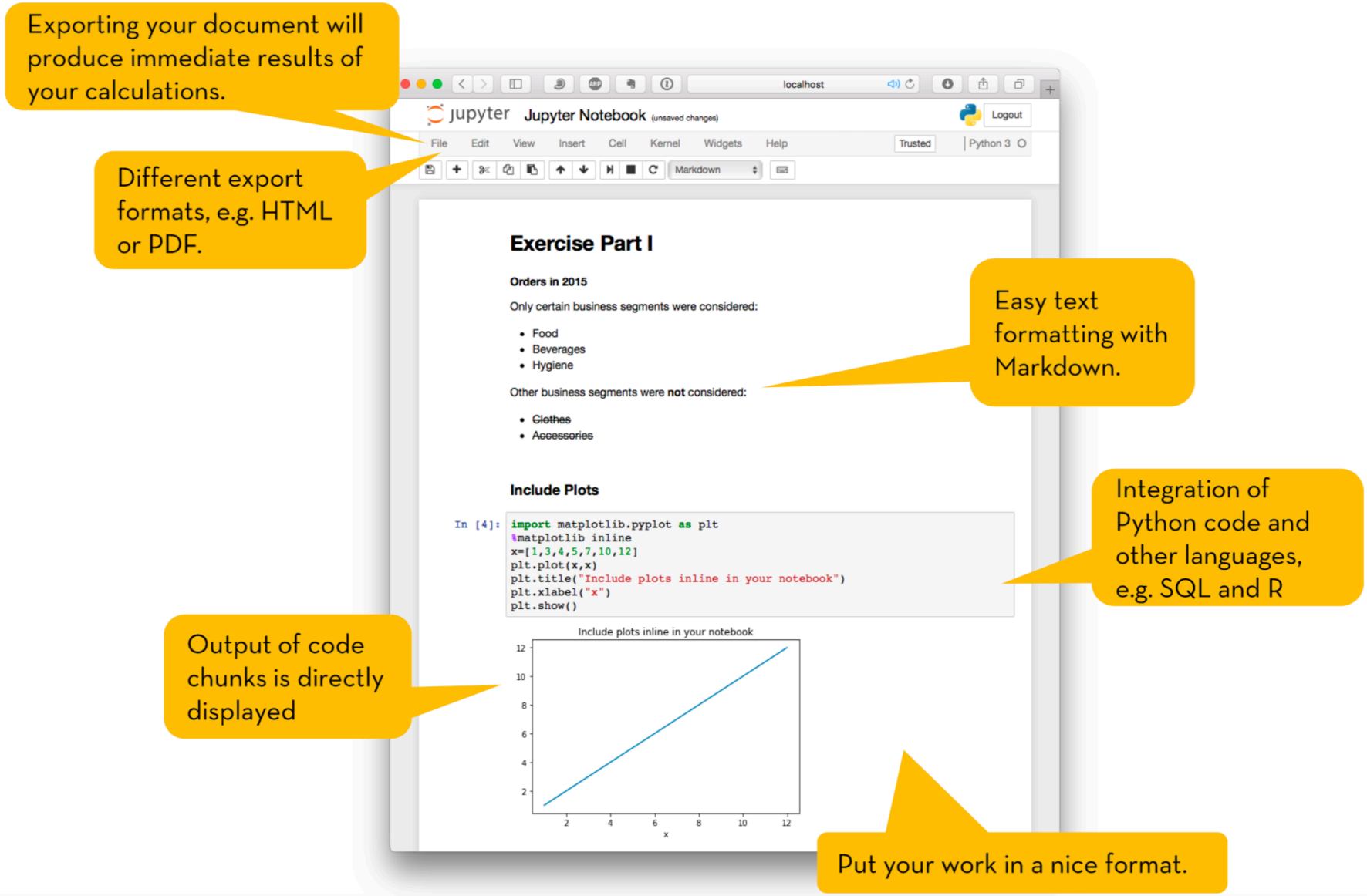
How to install Spyder

Go to the “Anaconda Navigator”



What is Jupyter Notebooks?

- Build small chunks of code
- Builds narratives
- Share them for online use



Notebooks vs regular programming scripts

Activity	Scripts	Notebooks
Building a narrative	**Comments** are available to describe code.	**Rich text** is available to describe the process and conclusion
Manage output	Output is available in the console or environment.	**Output is embedded** in a single document. Code and output may be divided into separate **code chunks**.
Creating a final report	**Creating a report is a separate** and time-consuming **step**.	**Instant report possible.** Reports are publishable as HTML, PDF, ...)

Allows very descriptive and reproducible documentation.

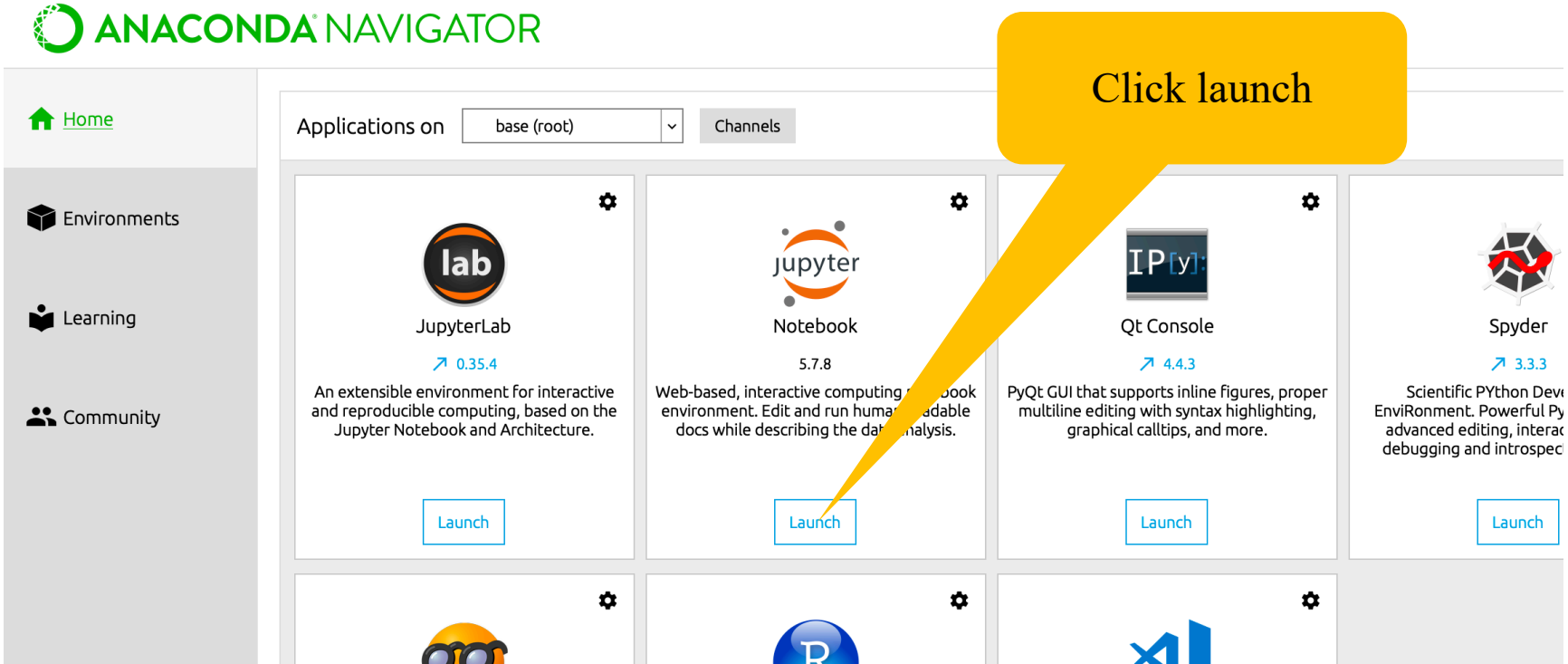
Immediate update of output and report

Easy sharing possible.

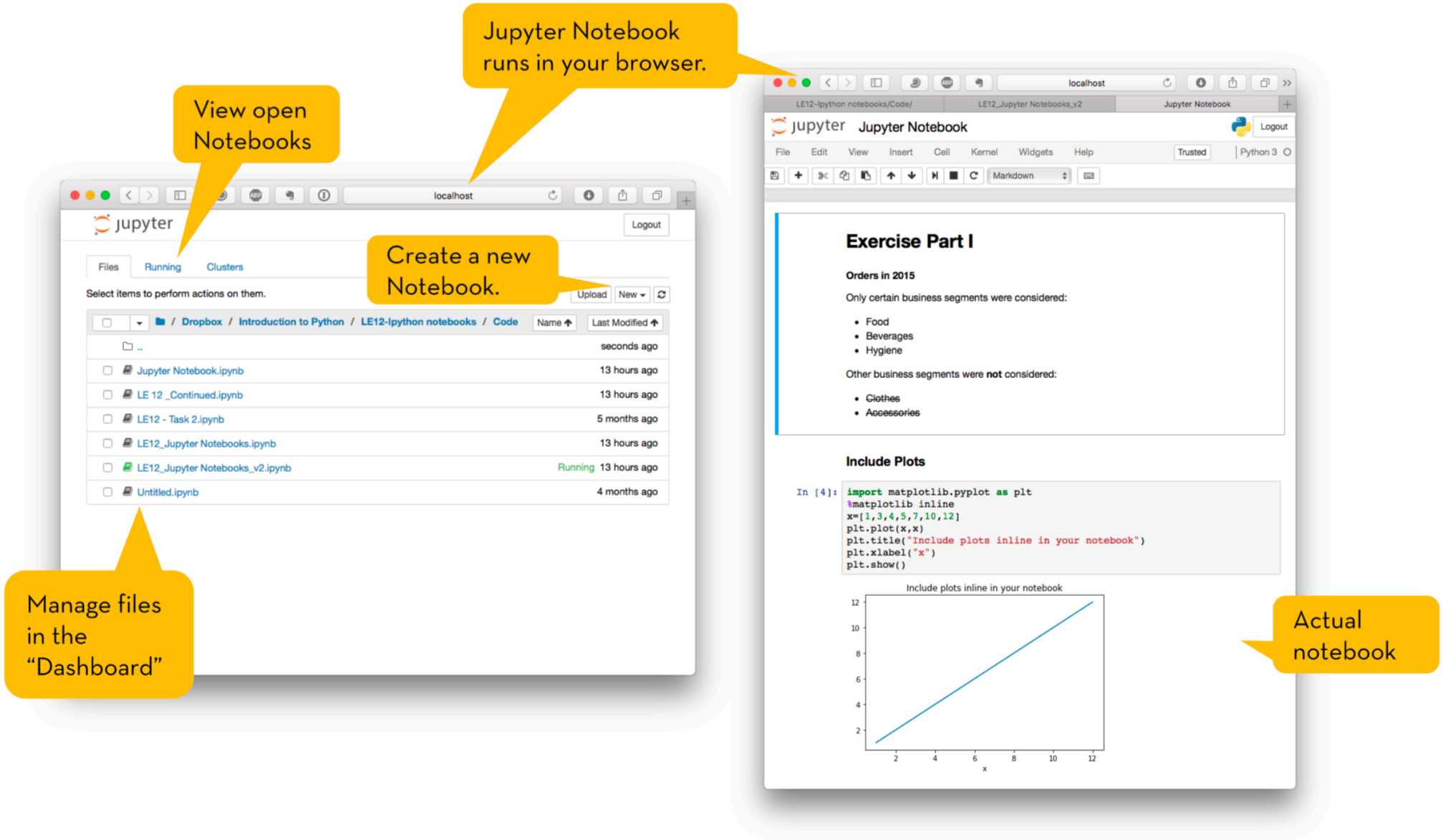
How to create your first Jupyter notebook

- Already installed with Anaconda
- Just go to command line and type: **`jupyter notebook`**

Just go to the “Anaconda Navigator”



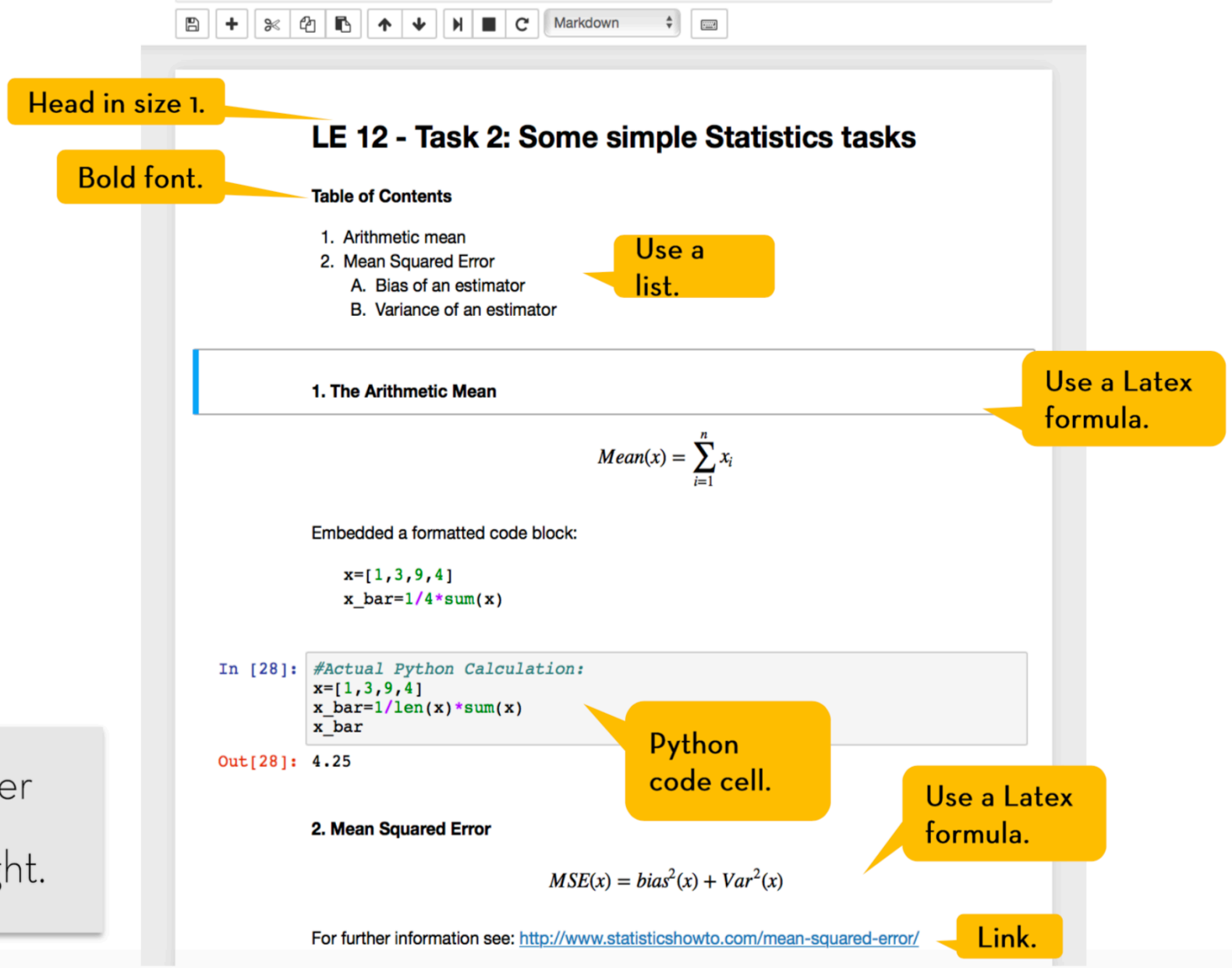
Main components of a Notebook



Lab Exercise 1: Notebooks

Notebook - Exercise

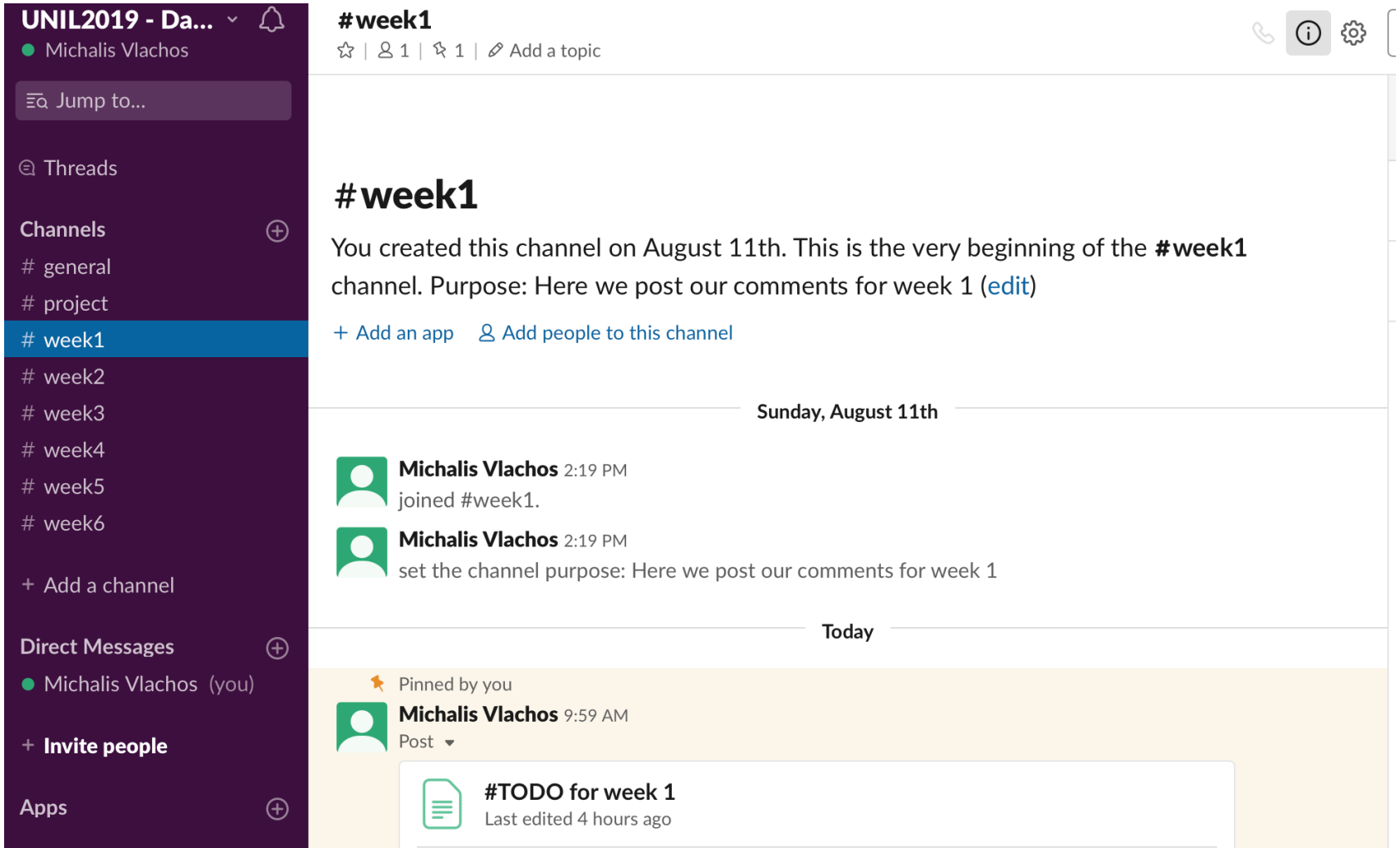
1. Re-create the Jupyter Notebook on the right.



Join Slack Workspace

Slack - Collaboration

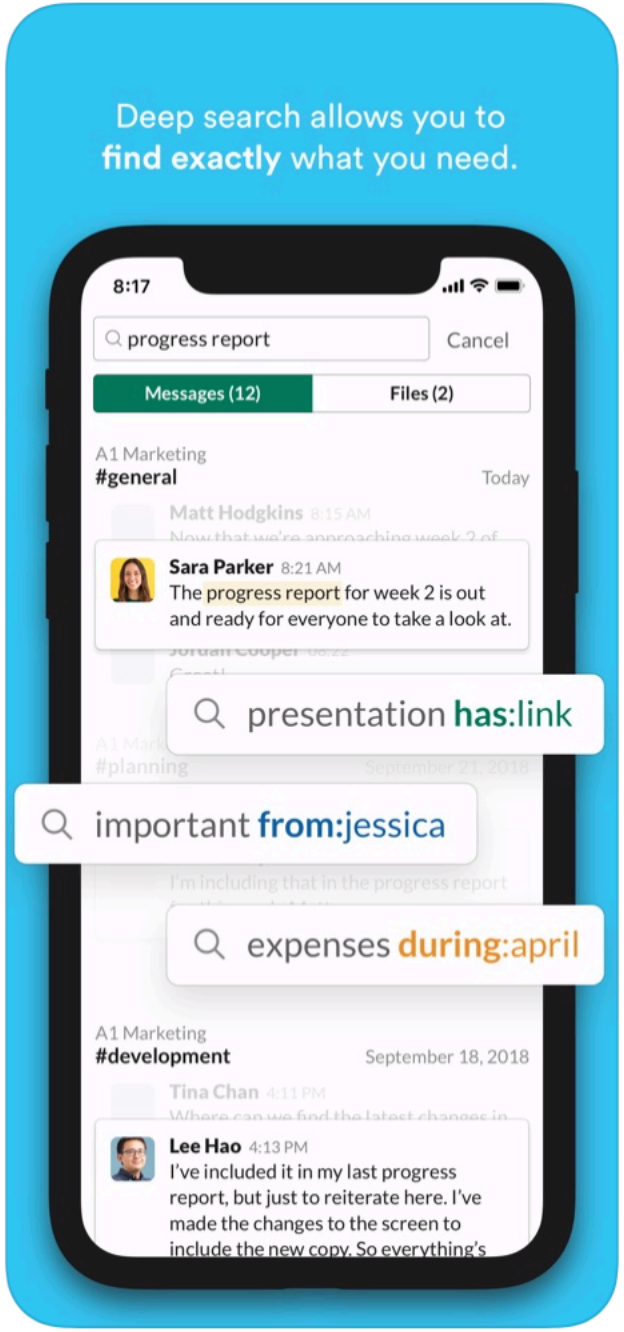
Join the workspace https://bit.ly/33tNiPR (use your UNIL email!)

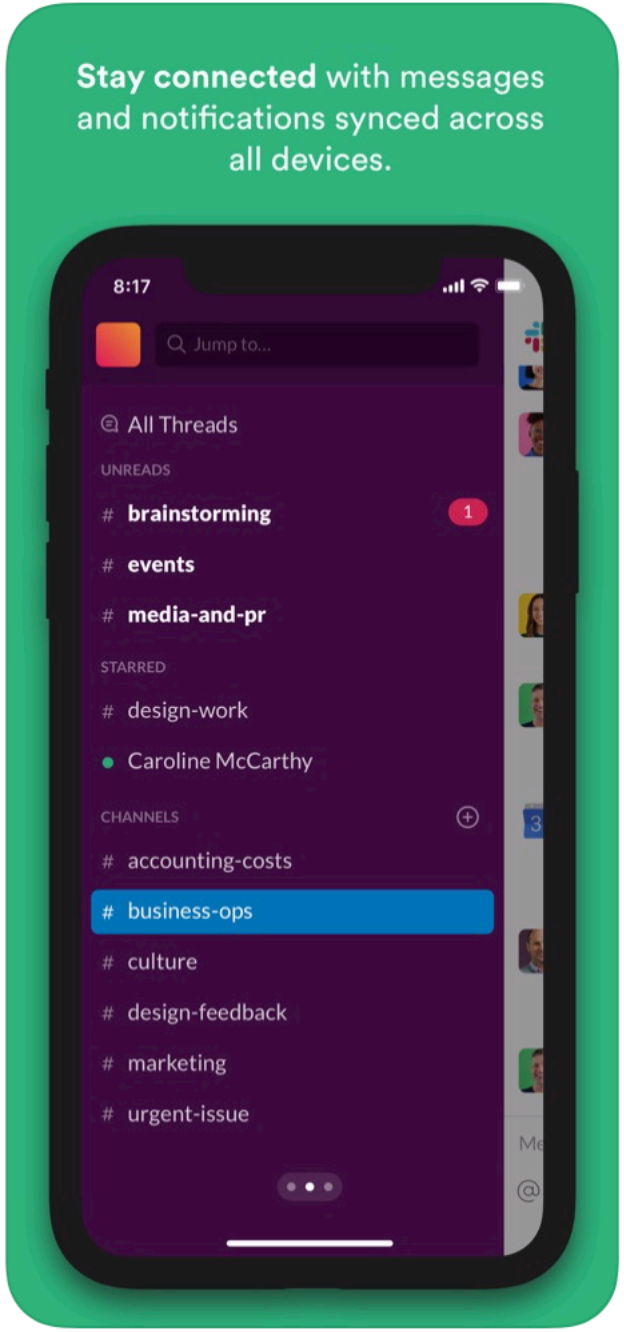


Slack clients

- It may be useful to download the app also for your phone.

- Check also a short video how to use slack.





Assignment 1

Goal: Familiarize yourself with how to create a compelling Python notebook.

Week 1 Assignment [personal]

- Find an interesting dataset from the Internet. It's better if the dataset is relatively new, e.g., after year 2000, and it should not contain only a few datapoints. You can find many in Kaggle. If the data is about Switzerland even better! The dataset may be in CSV, JSON, XLS or other format. Prepare a **Python notebook** that should answer in some narrative form the following:
- Task 1:
  - Describe the dataset. Why did you choose it? Where did you find it? What it is about? What attributes it contains? Types of attributes, ranges, etc. (if you don't know how do all, do as many as you can).
  - To answer the above you have to read the readme file, and look at the data. For this assignment you can with Excel (or you can use Pandas if you are familiar with it).
- Task 2:
  - What kind of questions would one be interested to ask/answer about this dataset?

Week 1 Assignment

- Task 3
  - Prepare a **short video** (1-2mins) with the following content:
    - Your name and student ID.
    - The dataset and where you found it.
    - What questions one can ask on it?
    - (optional) Any basic analysis you may have conducted on it (analysis in pandas, visualization).
  - The video should include voice-over and also the face of the narrator in the beginning.
  - To create the video, you may use Camtasia or Quicktime Player. **Upload** it in youtube and embed the link in the notebook (as in the Lab assignments).

- Task 4
  - In the slack channel of **week 1**, write your name and email, the name of the dataset, the link to your video.

Week 1 Assignment

Task 5:

- Visit the class slack channel, and comment about which video and/or dataset you liked the most (other than yours!). This will be credited to your class participation points.

In week 2, I will select a few of these videos to show in class.

TODO for Week 1

1. Join class workspace at: https://bit.ly/33tNiPR (use your UNIL email!)

Very IMPORTANT!
If you want to get participation credit you should use your UNIL email!

There is more in the next page!

TODO for Week 1

1. Join class workspace at: https://bit.ly/33tNiPR (use your UNIL email!)
2. Read the article "Data Scientist: The Sexiest Job of the 21st Century" from HBR.
3. Prepare and submit assignment 1.
4. a) Post the link to the video from assignment 1 on the **"week1" channel** in the workspace.
   b) Comment on other's people's videos (class participation!).
5. Go over week1 slides.
6. Go over the Python notebooks (notebook basics, pandas basics) we did in class.