Introduction to Machine Learning

Khoren Petrosyan
Machine Learning. Winter 2021

Companies:

BetConstruct LLC
Develandoo

Teaching:

ISTC (2018-2019)
YSU (2019-2021)
ACA (2021-now)

Course Outline

- Data Visualization
- Regression Algorithms
- Classification algorithms
- Feature transformations
- Model evaluation techniques
- Neural Networks

Lecture Outline

- What is Machine Learning?
- Machine Learning types
- Practical examples in different fields
- Useful tools

Data Science vs Machine Learning

DS -> using scientific approach to extract meaning and insights from data

ML -> a group of techniques that allow computers to learn from data

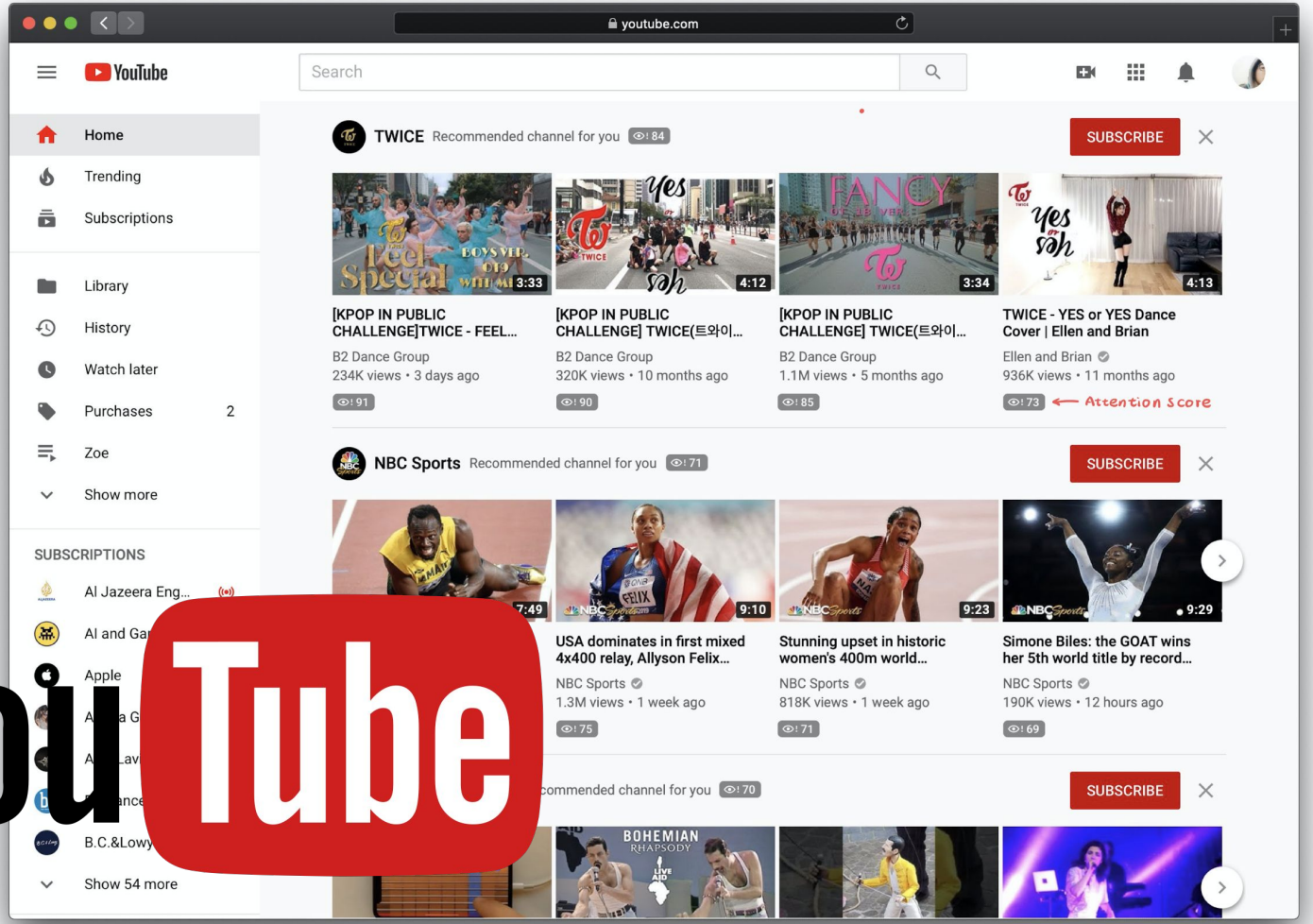
Machine Learning

ML -> applying algorithms and generating results?

- **Data preprocessing can be as much as 80-90% of the work**
  - Data Science
  - Data cleaning
  - Transformations

What is Machine Learning?

- Data is everywhere and in every field
- Huge amounts of data collected and stored
- Machine learning techniques in our everyday lives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B2 Dance Group
234K views • 3 days ago
91
3:33
[KPOP IN PUBLIC CHALLENGE] TWICE(트와이...
B2 Dance Group
320K views • 10 months ago
90
4:12
[KPOP IN PUBLIC CHALLENGE] TWICE(트와이...
B2 Dance Group
1.1M views • 5 months ago
85
3:34
TWICE - YES or YES Dance Cover | Ellen and Brian
Ellen and Brian
936K views • 11 months ago
73
Attention Score
4:13
NBC Sports Recommended channel for you 71
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USA dominates in first mixed 4x400 relay, Allyson Felix...
NBC Sports
1.3M views • 1 week ago
75
9:10
Stunning upset in historic women's 400m world...
NBC Sports
818K views • 1 week ago
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9:23
Simone Biles: the GOAT wins her 5th world title by record...
NBC Sports
190K views • 12 hours ago
69
9:29
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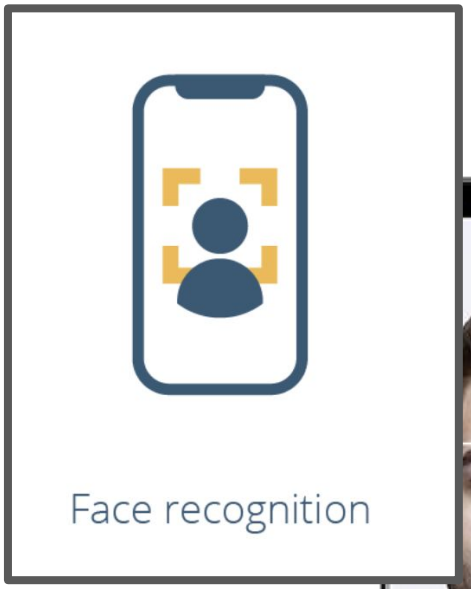
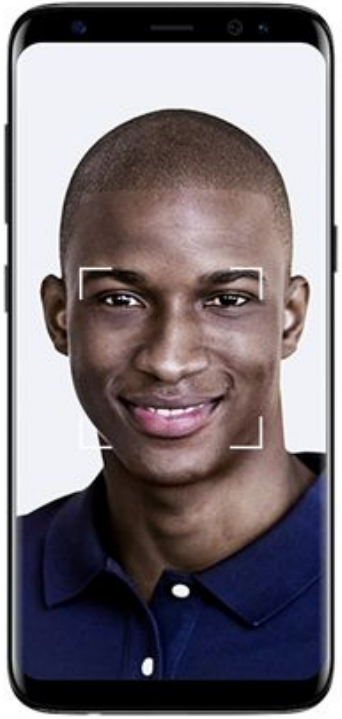

Face recognition




Voice assistant

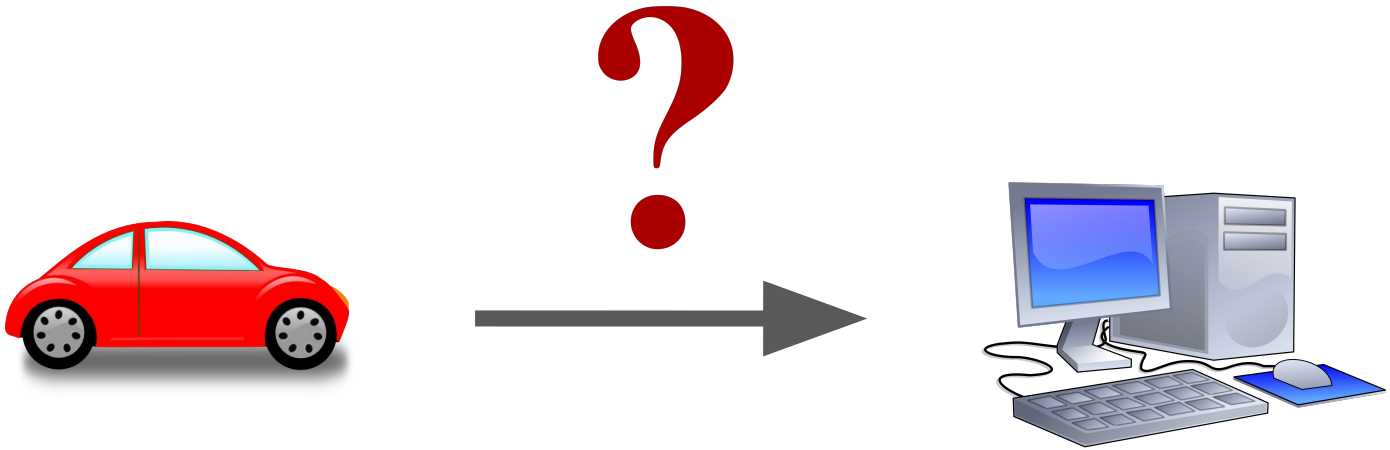

Pure Clean
Vacuum robot

Movies suggestion

What is Machine Learning?

Machine learning is a study of computer algorithms that improve automatically through experience.

?



Training Data

Test Data

$

Size of house

Size of garden

Number of rooms

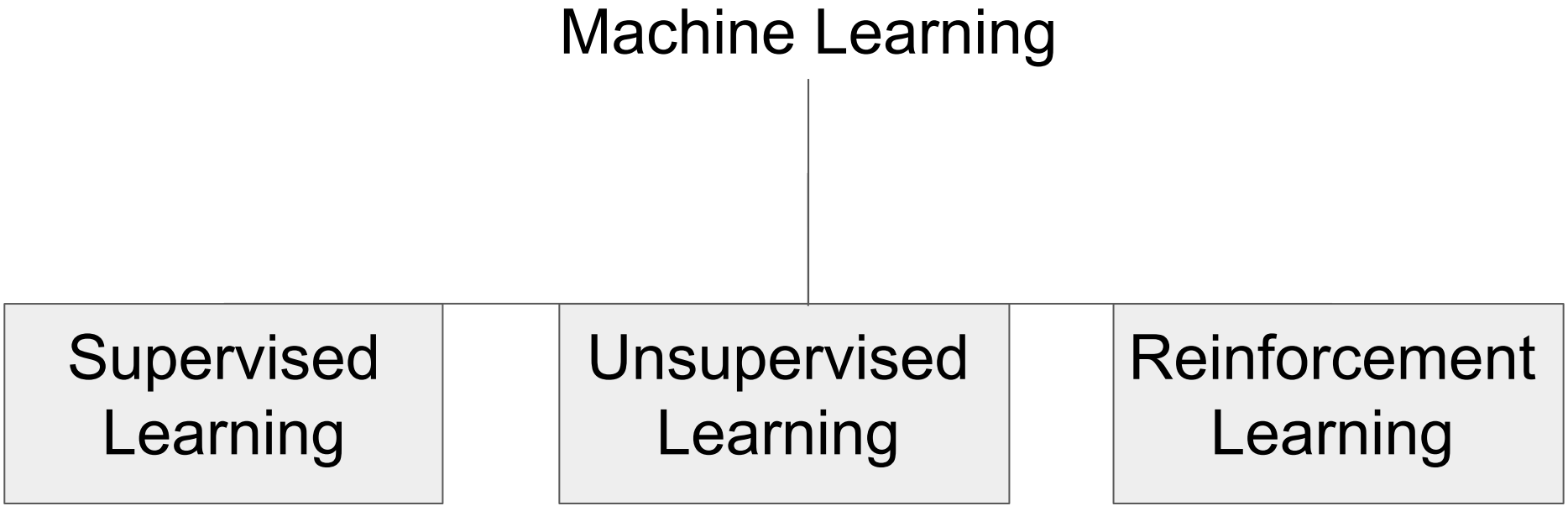
$$\$ = 1.2 \times \text{size of house} + 0.7 \times \text{size of garden} + 3.1 \times \text{number of rooms}$$


$ = A × + B × + C ×
Model with unknown A, B and C to be defined

< Model


$
1
2
3
4
...
Available data to determine A, B and C
(to fit the model)

< Data

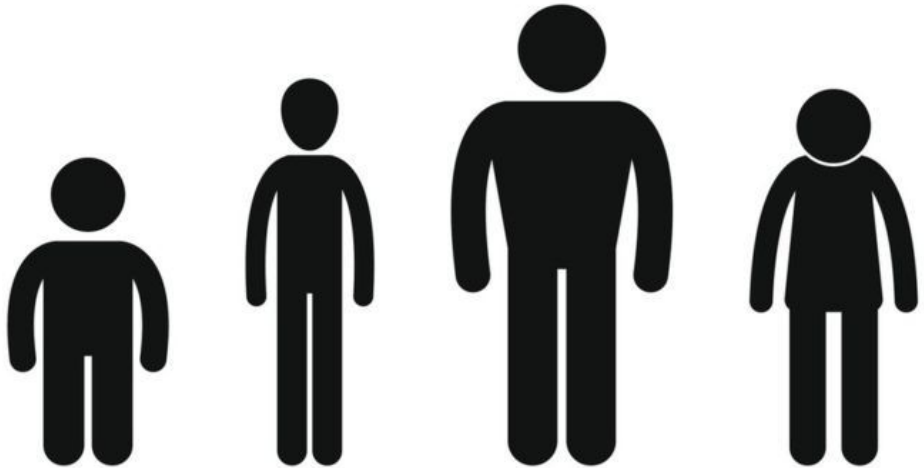

Machine Learning
Supervised Learning
Unsupervised Learning
Reinforcement Learning

Supervised Learning

A supervised model is trained on a labeled dataset of (feature, label) pairs.

Regression Model - numerical label

Problem: Predict weight (number) given height and age

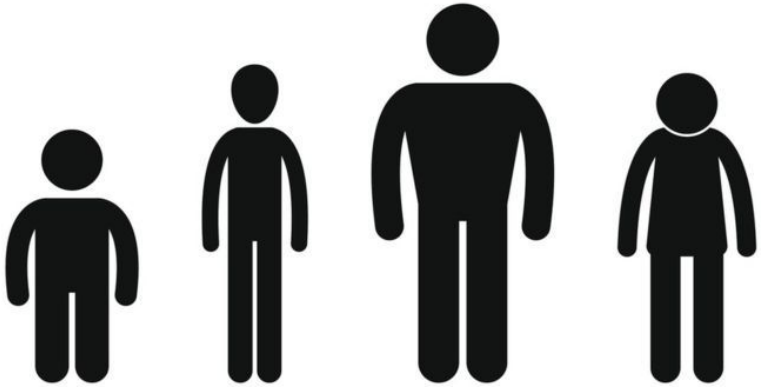


Features:

Height, Age

Label:

Weight

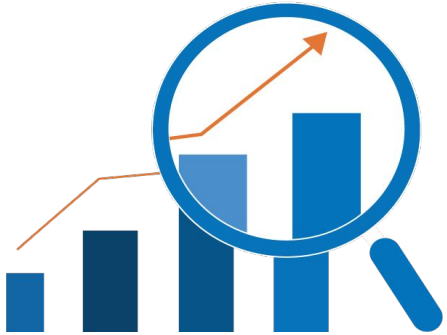


Height:	1.50	1.70	2.10	1.55	1.62
Age:	10	24	40	20	30
Weight:	40	58	80	45	**?**

Training data

Test data

Predictive Analytics



Forecasting future opportunities and risks

- Demand analysis
- Billboard advertisement bid
- Insurance companies use cases
- Etc.

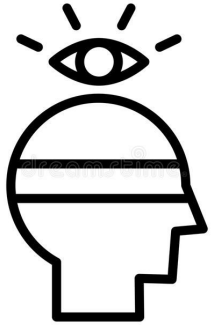
Operation Efficiency

Oven temperature vs shelf-life of cookies

Call center:

- Call wait time vs number of complains

Testing intuition



Support for decisions and preventing mistakes

Example: shopping hours increase -> sales increase?

Example: changing some part of device -> more satisfied customers?

Classification Model - categorical label

Problem: Predict if the object is an apple or not (True/False) given color and shape.

Features:

Color, Shape

Label:

True/False





Color:	red	yellow	green	yellow	Green
Shape:	round	round	oval	oval	round
Apple:	True	True	False	False	**?**

Training data

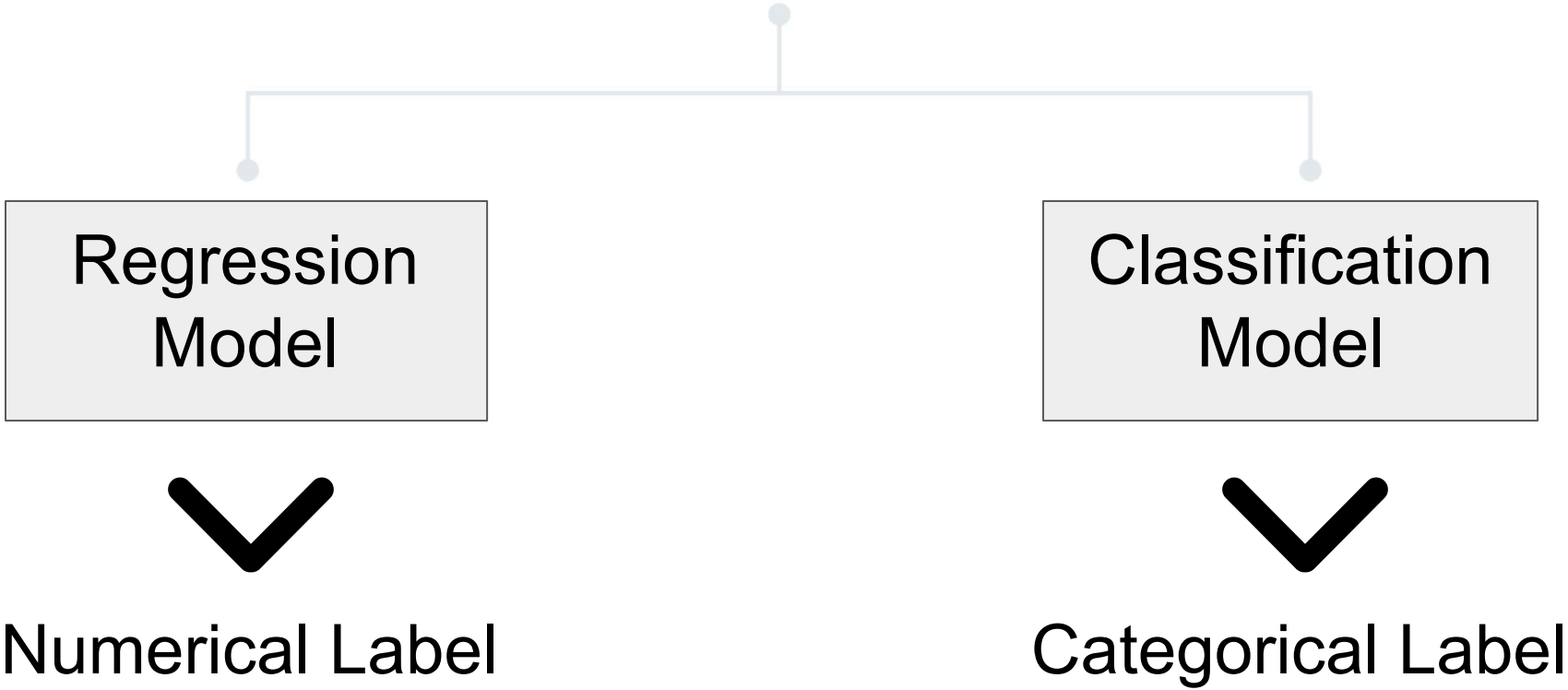
Test data

More examples

Detecting spam emails (spam vs ham classification)

Music identification (recommending what the person likes)

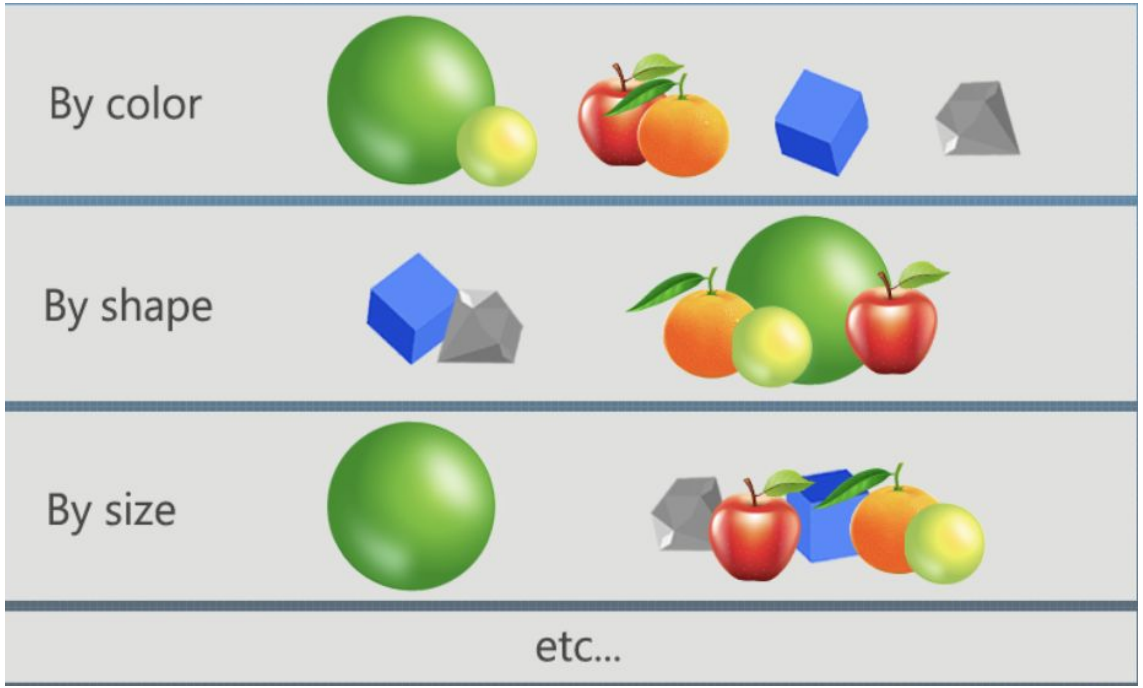
Supervised Learning



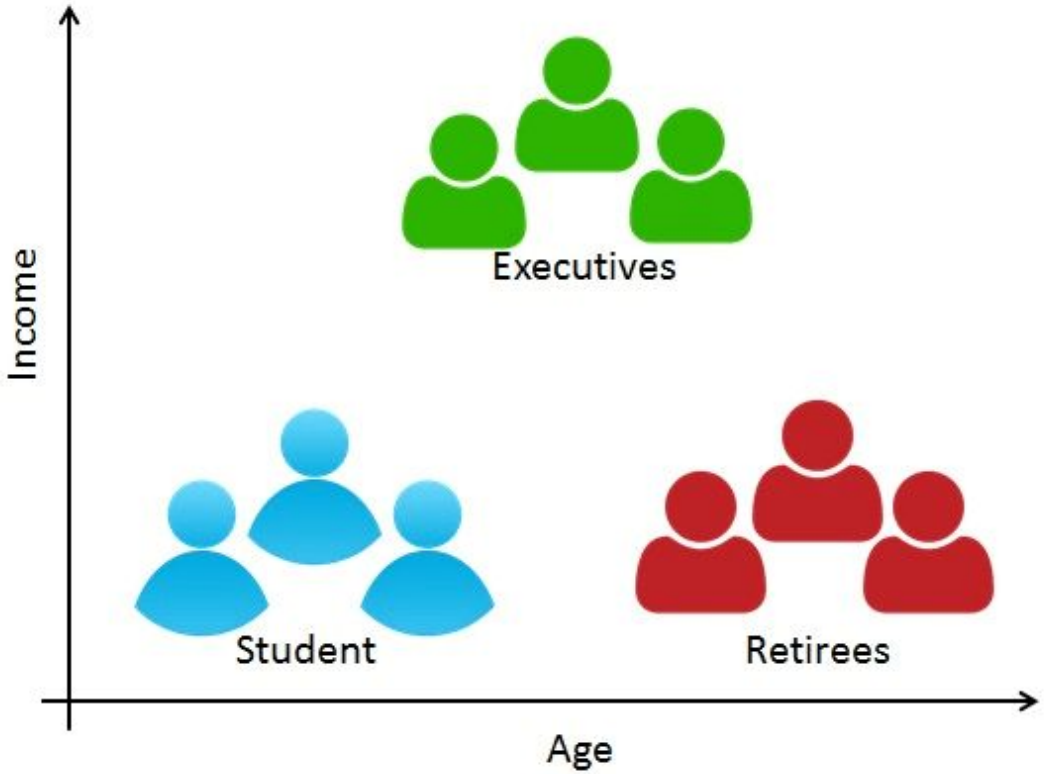
Unsupervised Learning

An unsupervised model is trained on a unlabeled dataset that contains only features but with NO labels

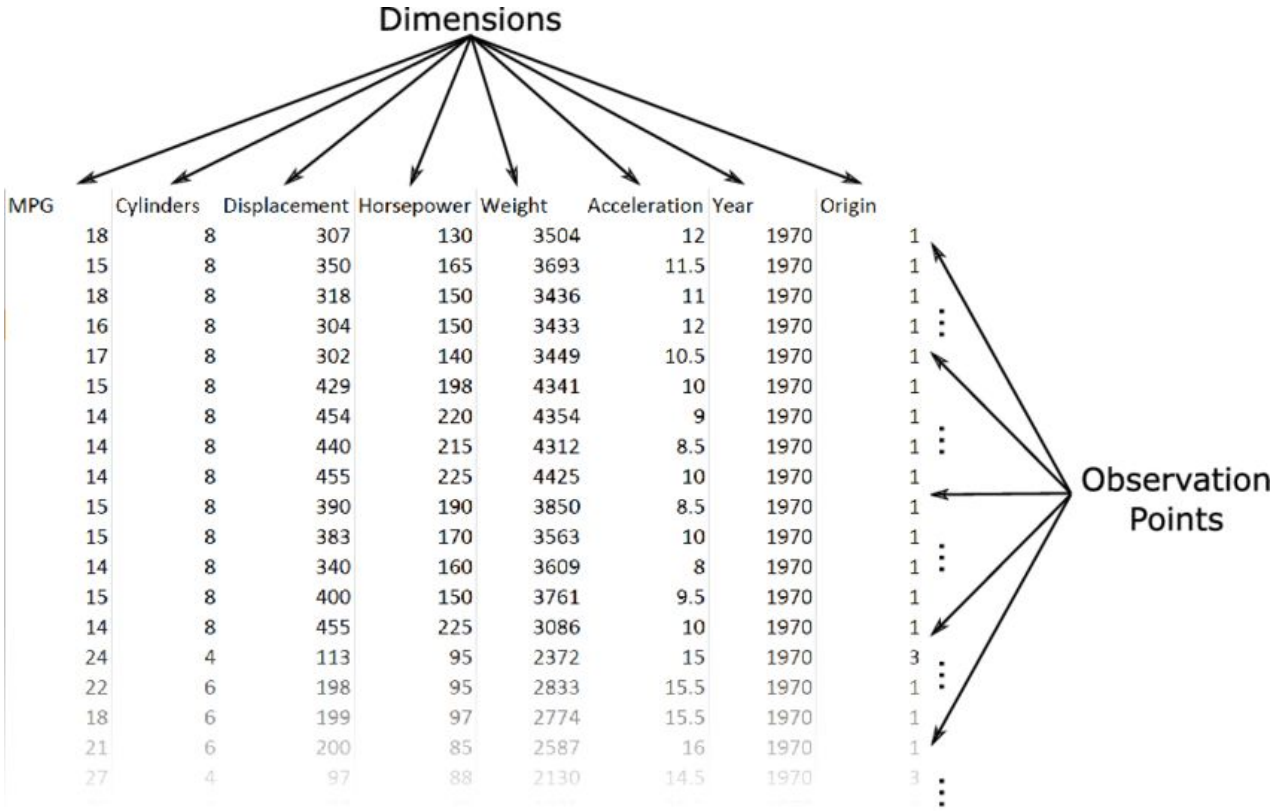
Clustering model - group similar instances together



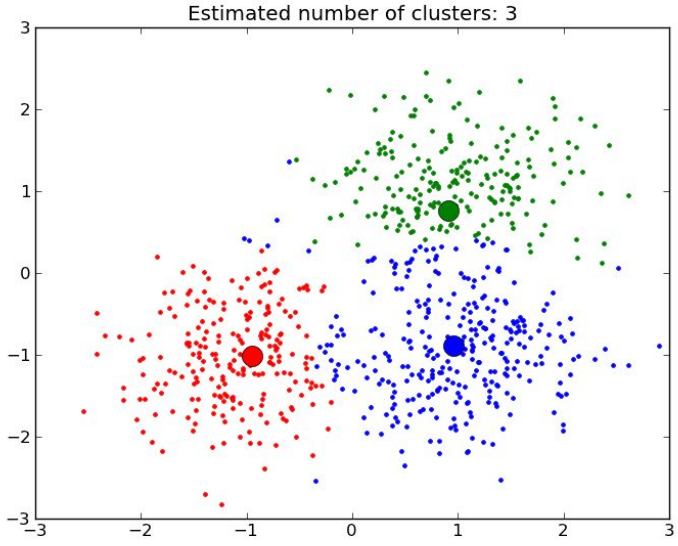
Clustering model - customer segmentation given income and age

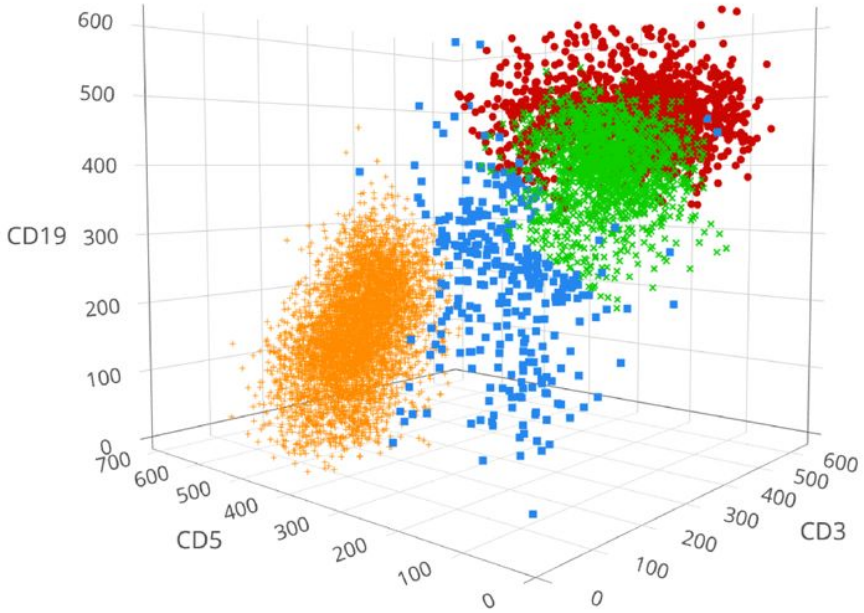


Dimension reduction model - express data with 2-3 dimensions

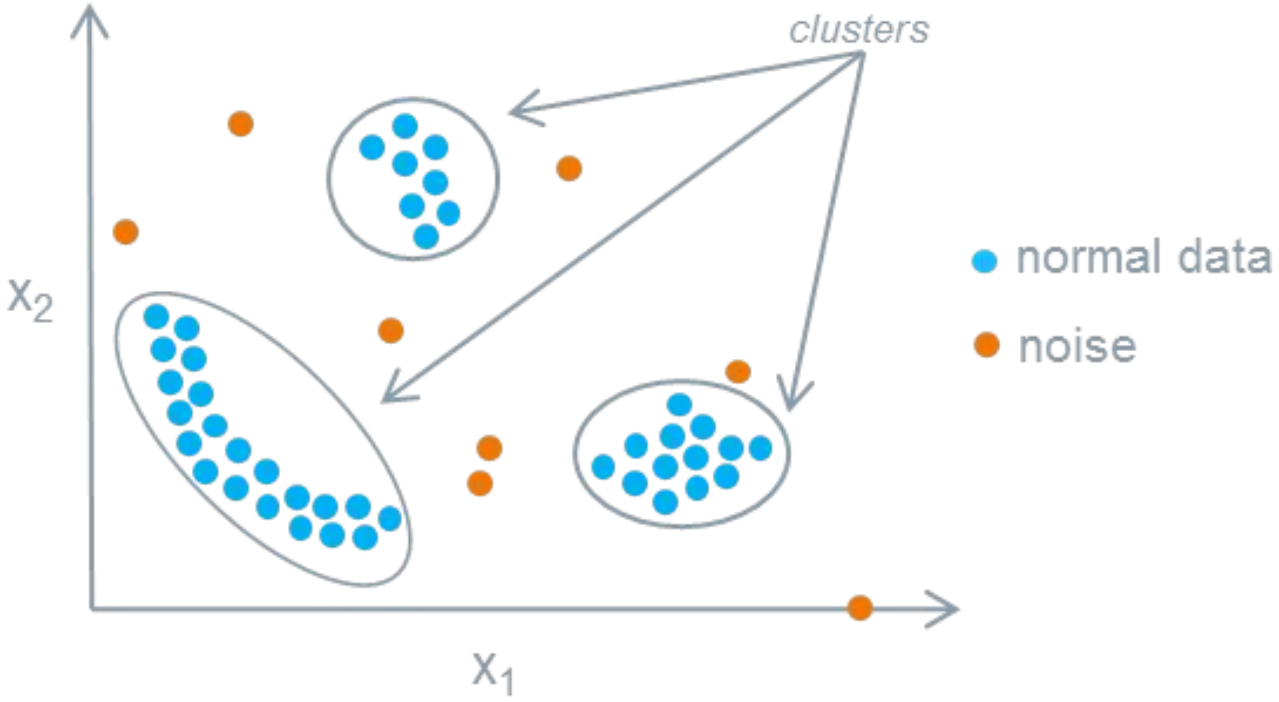


Dimension reduction model - express data with 2-3 dimensions

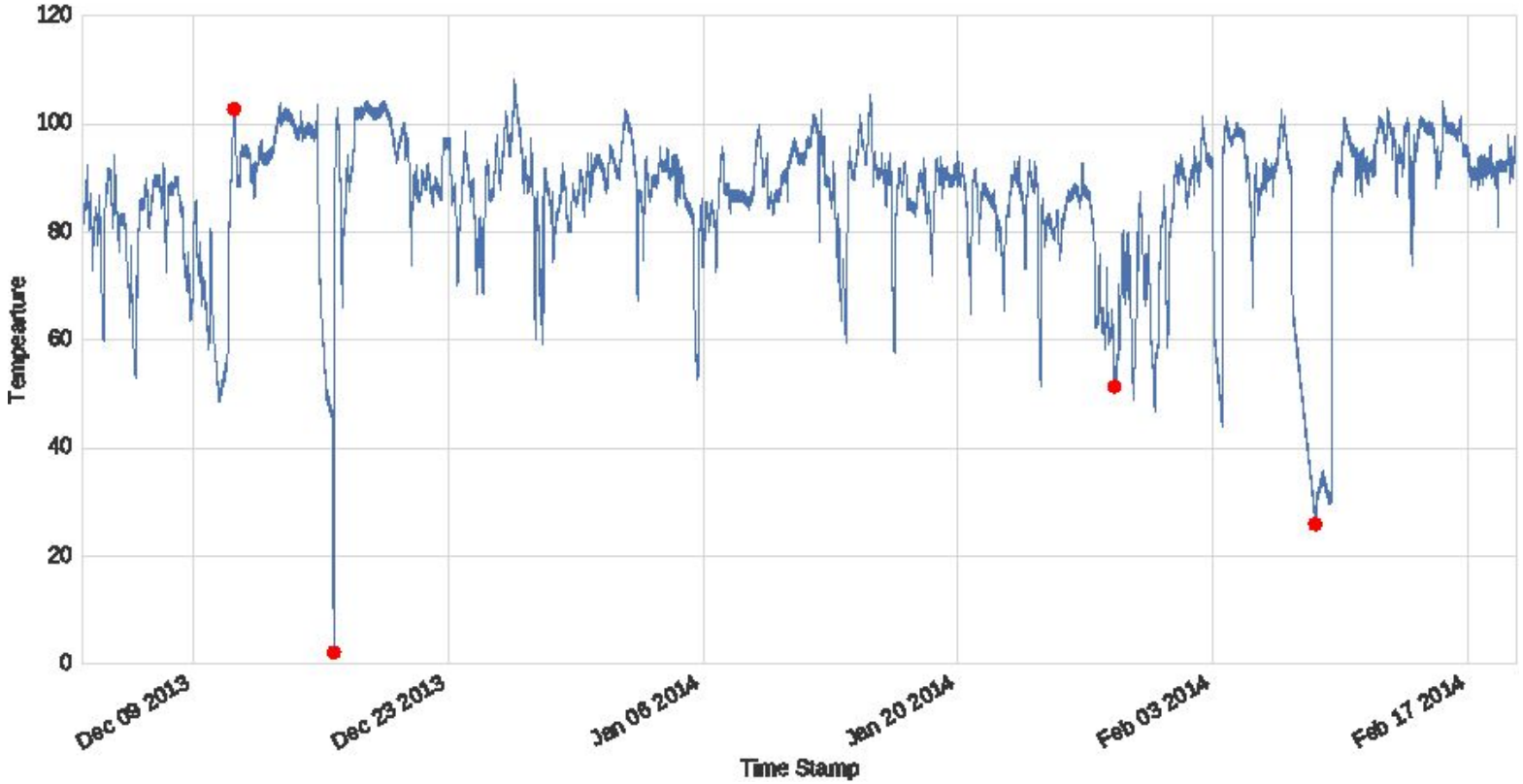




Anomaly detection - finding outliers



Anomaly detection - finding outliers



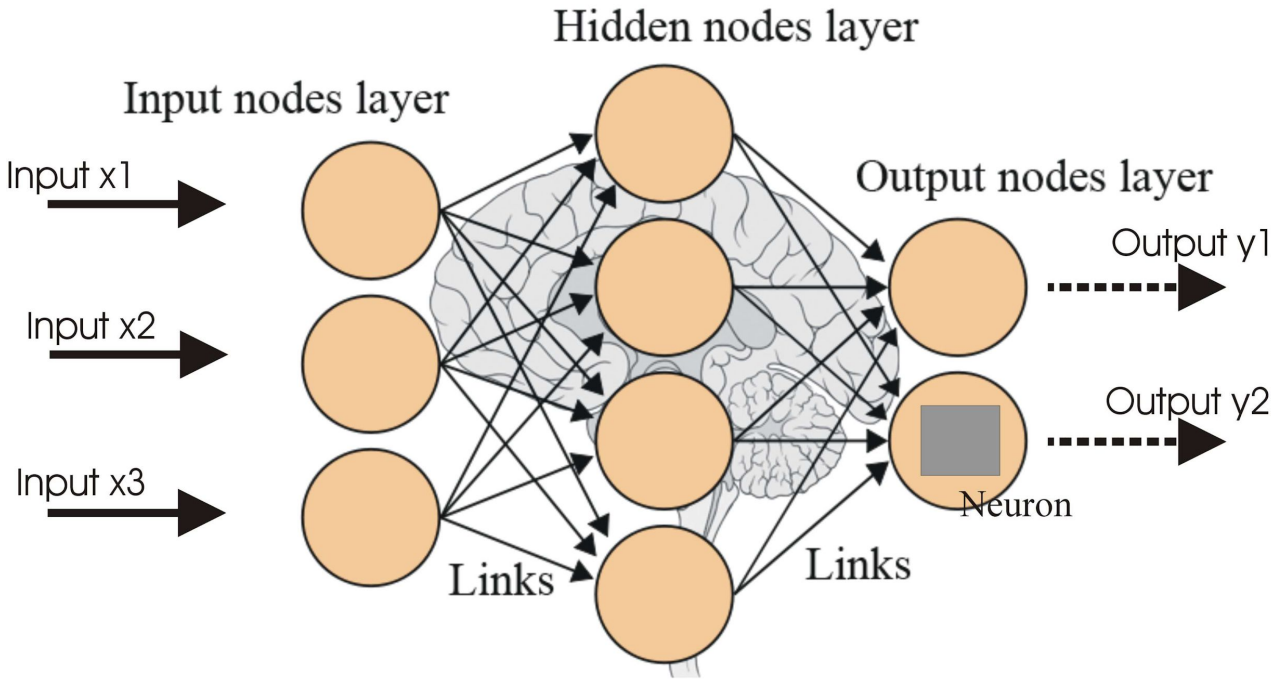
More examples

Detecting issues on celular stations

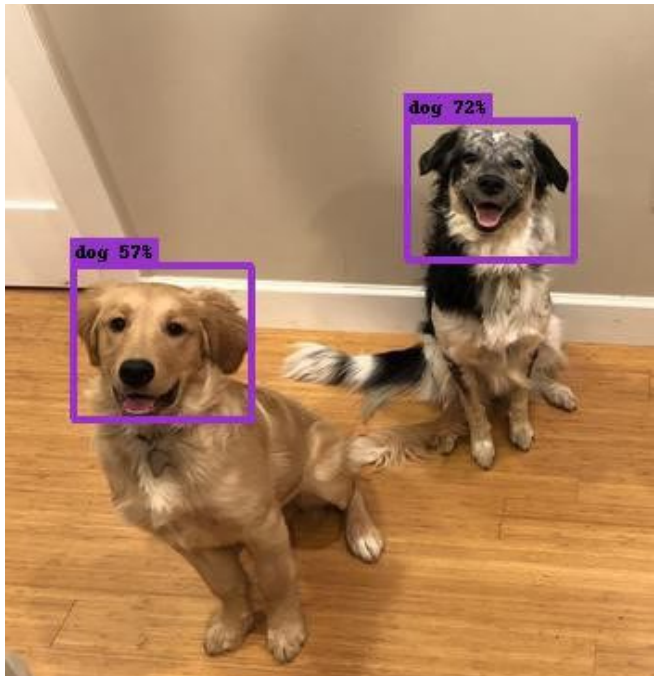
Detecting anomalous return rates

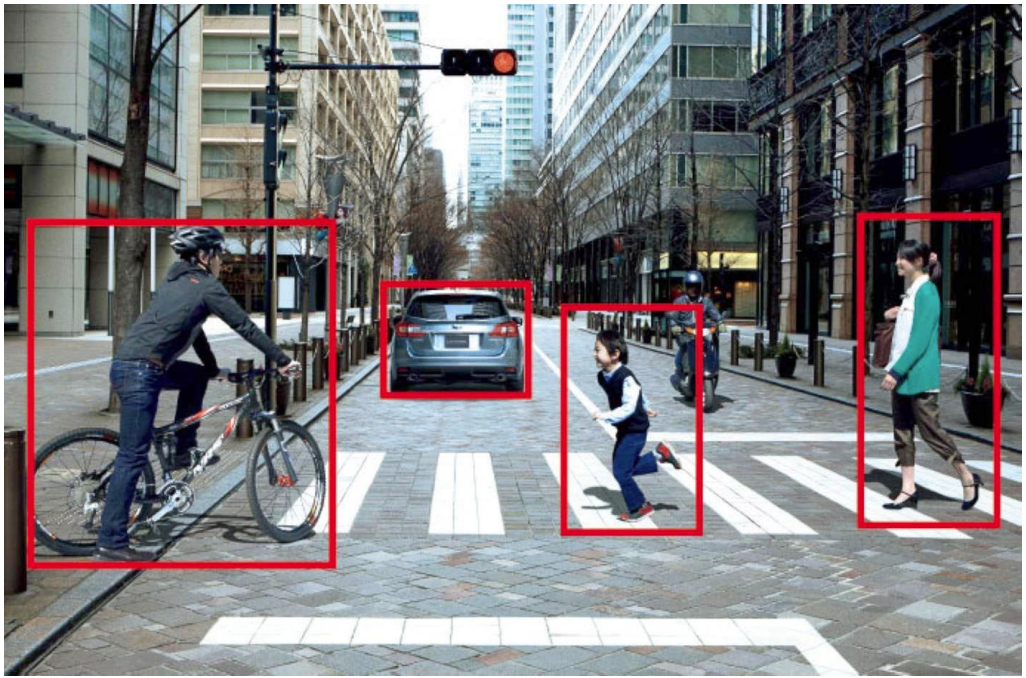
Anomalous behavior of network users

Neural Networks



Convolutional Neural Networks



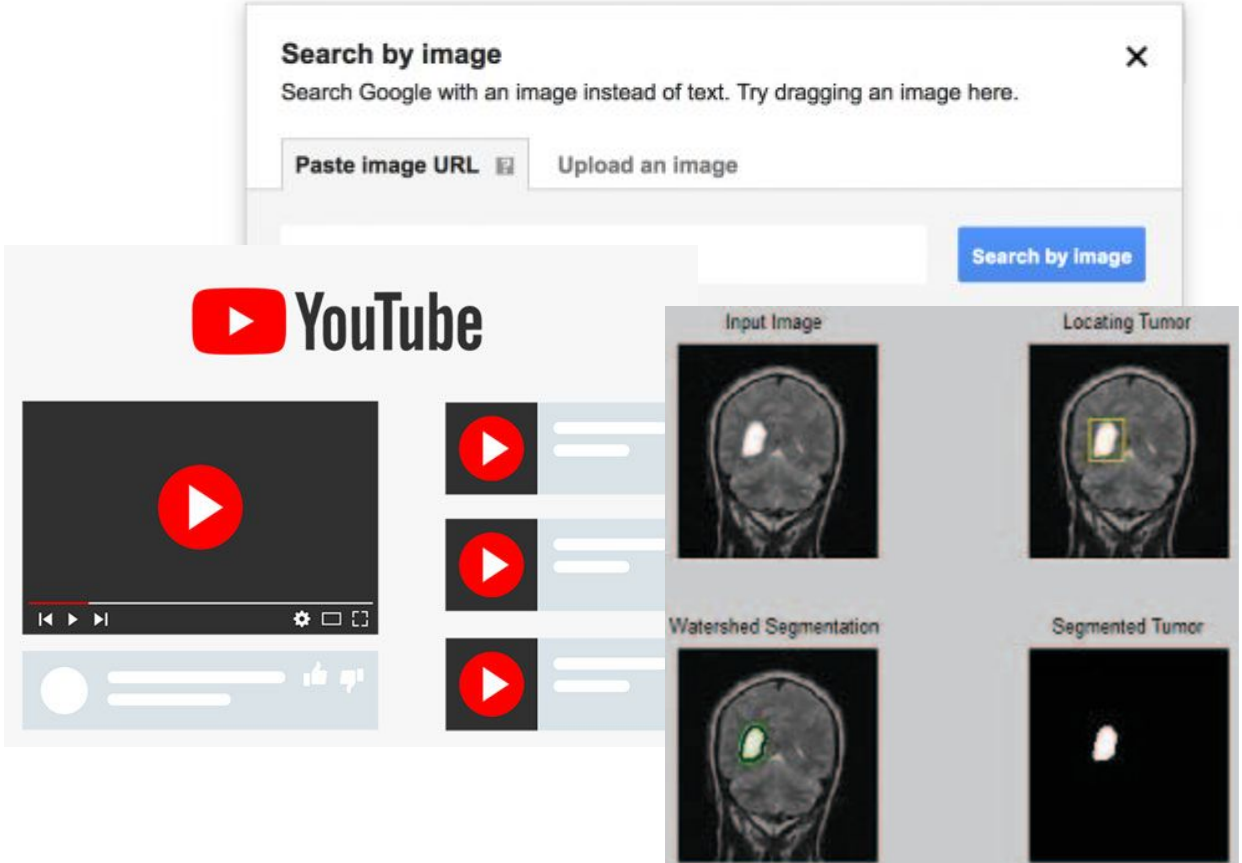


More examples

Visual search

Recommender engines

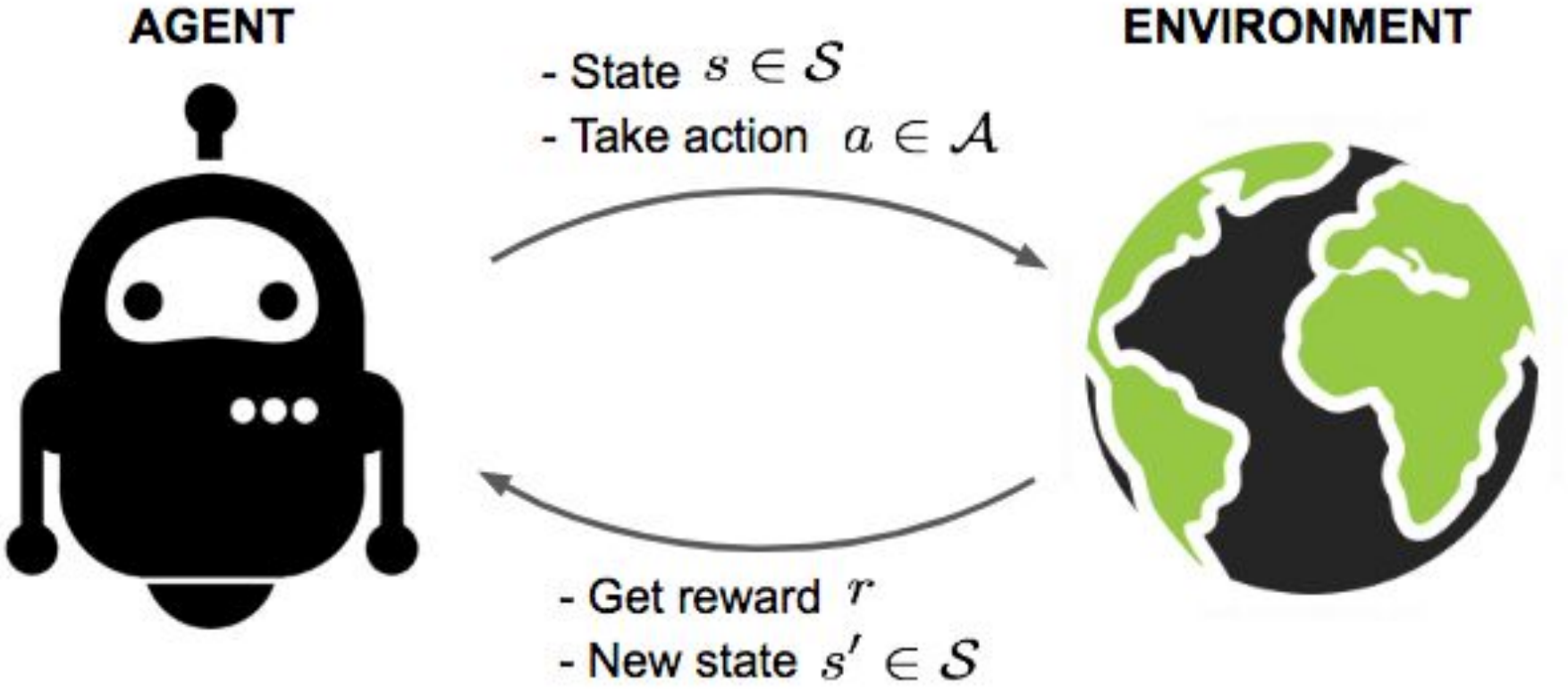
Tumor identification



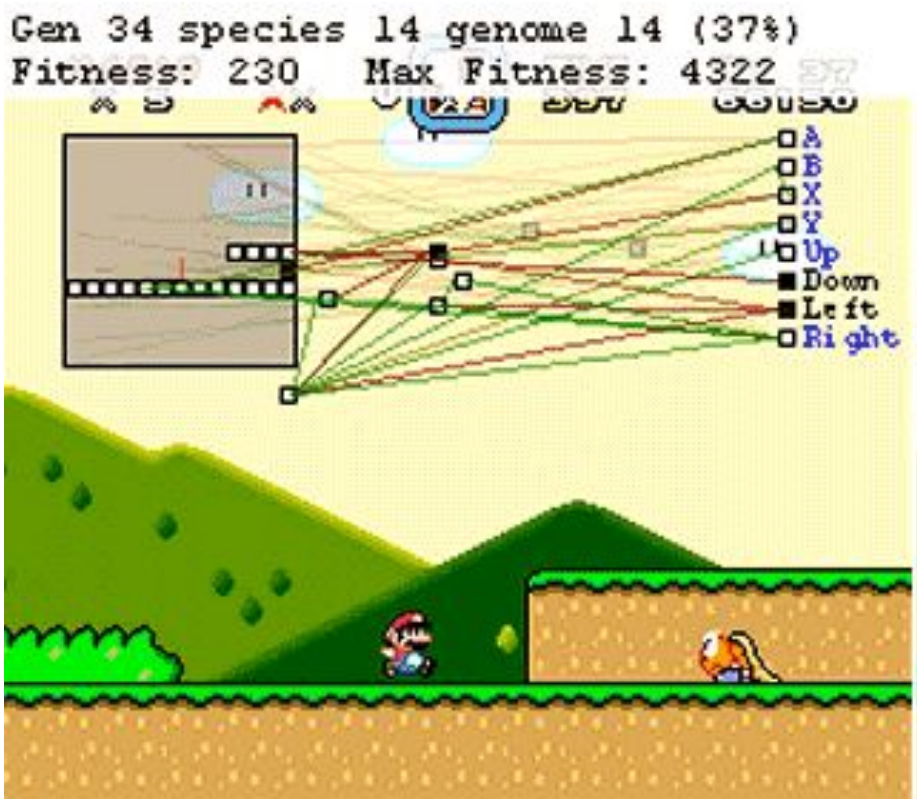
Reinforcement Learning

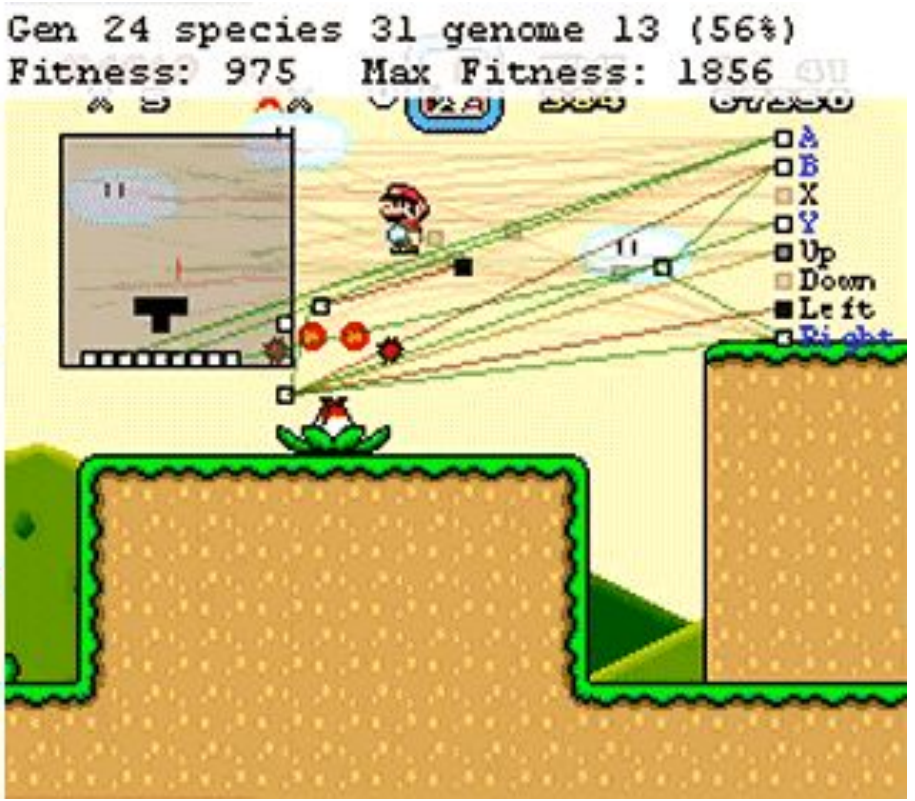
Train a machine learning model to generate a sequence of decisions

(Model)


AGENT
ENVIRONMENT
- State $s \in \mathcal{S}$
- Take action $a \in \mathcal{A}$
- Get reward r
- New state $s' \in \mathcal{S}$

Mario game


Gen 34 species 14 genome 14 (37%)
Fitness: 230 Max Fitness: 4322
A
B
X
Y
Up
Down
Left
Right


Gen 24 species 31 genome 13 (56%)
Fitness: 975 Max Fitness: 1856
A
B
X
Y
Up
Down
Left

Autonomous car navigation

Environment: street model

Set of actions: 

Scoring: penalty/reward

https://www.youtube.com/watch?v=3ROVzjkkCIA

Thank you!