INTRODUCTION TO MACHINE LEARNING

MUSTAFA ALDEMIR, INTEL TURKEY

AI IS THE NEW ELECTRICITY

«Just as electricity transformed almost everything 100 years ago, today I actually have a hard time thinking of an industry that I don't think AI will transform in the next several years.»

Dr. Andrew Ng

OUTLINE

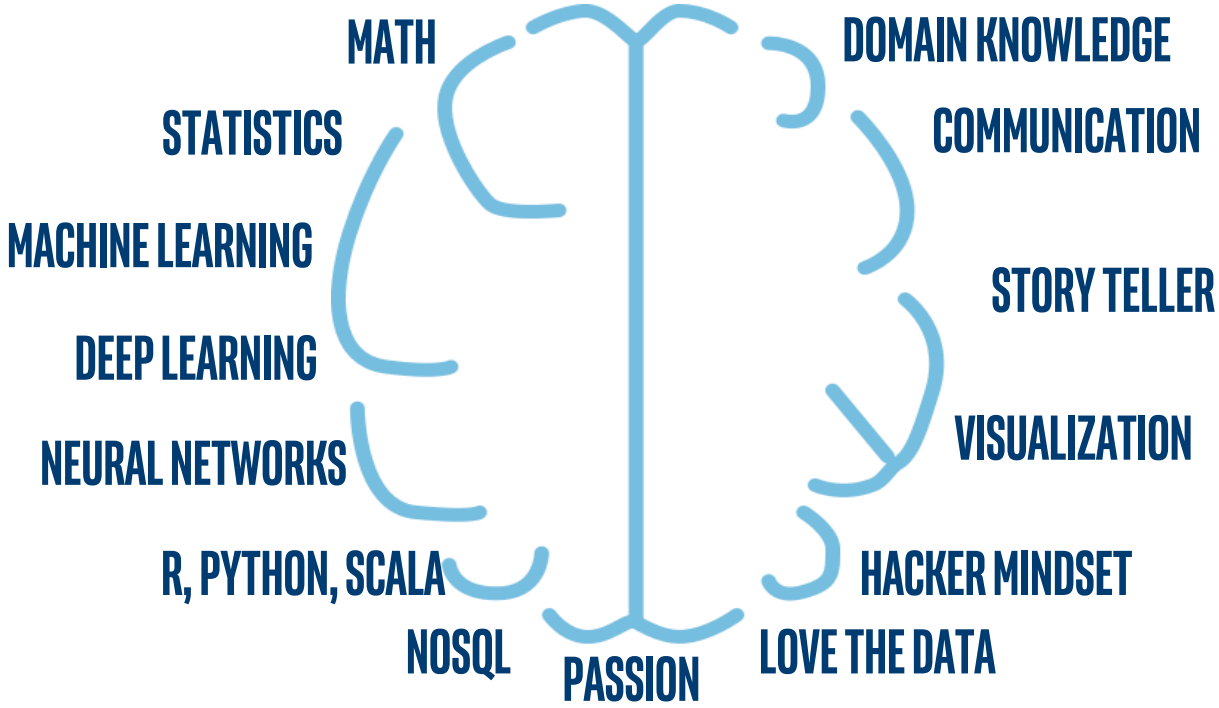
- Introduction to Data Science
- Introduction to Machine Learning
  - Supervised Learning
  - Unsupervised Learning
- Some Implementation
- Q&A

- Introduction to Deep Learning
  - Artificial Neural Networks
  - Convolutional Neural Networks
- Intel Deep Learning Training Tool
  - Installing
  - Using
- Q&A

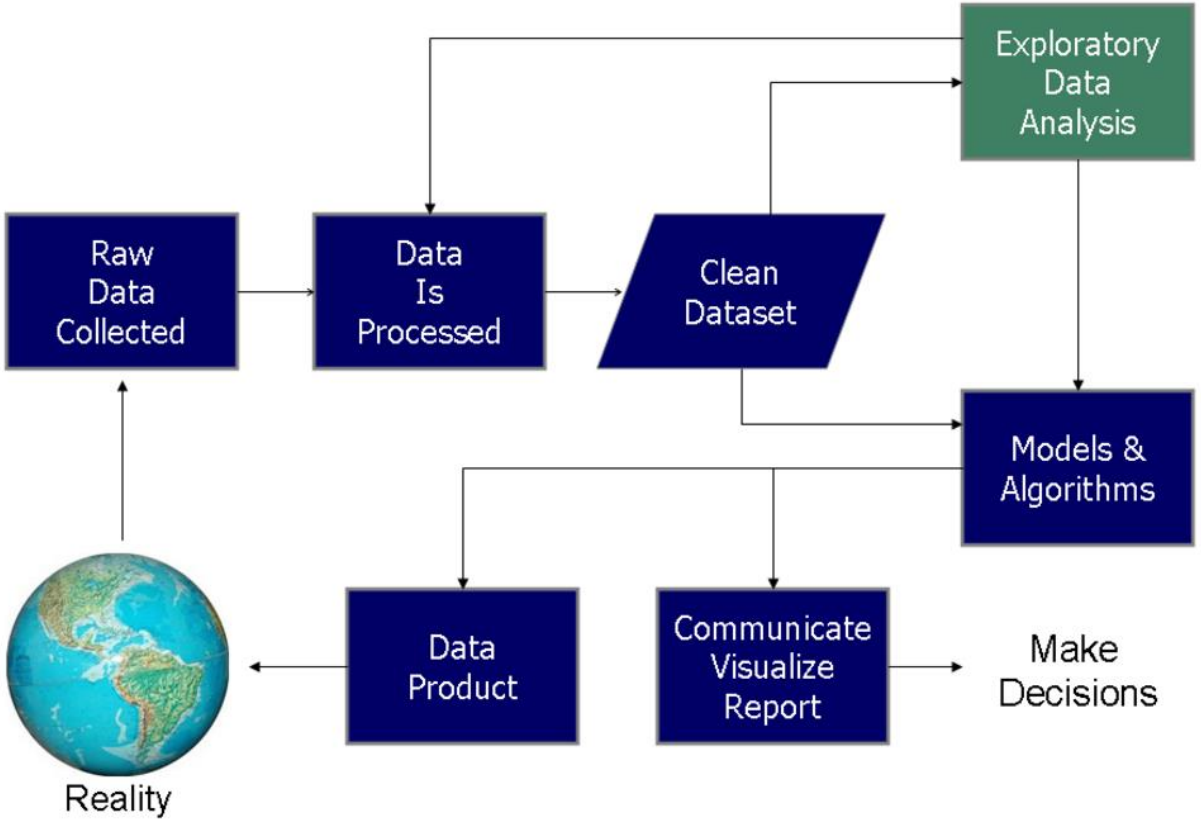
WHAT IS DATA SCIENCE?

The science of extracting knowledge and information from data and requires competencies in both statistical and computer-based data analysis.

HOW TO BECOME A DATA SCIENTIST?



The Data Science Process



Source: https://en.wikipedia.org/wiki/Data_science

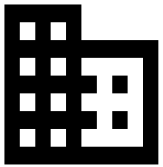
DAILY DATA GENERATION IN 2020

1.5GB

3,000GB

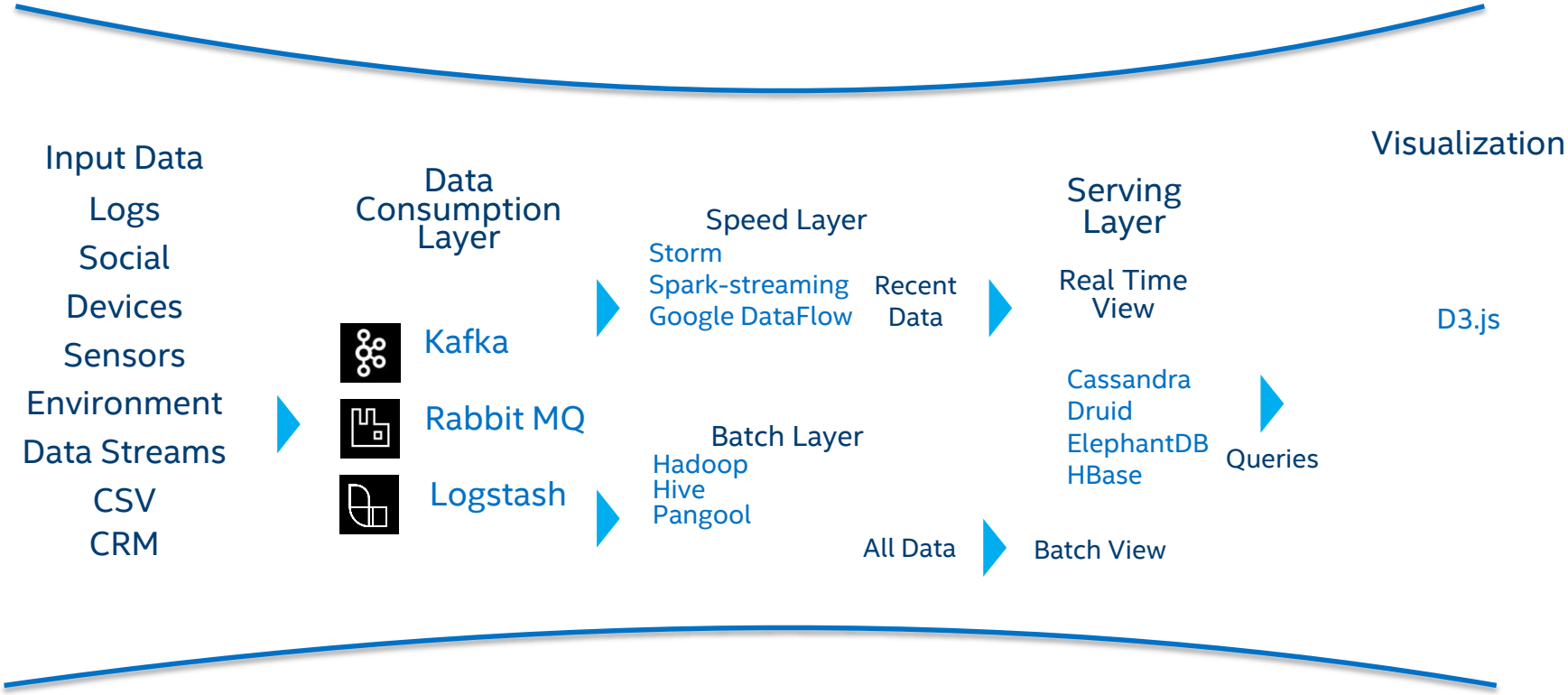
4,000GB

40,000GB



1,000,000GB

DATA SCIENCE - INGESTION TO VISUALIZATION



WHAT IS ARTIFICIAL INTELLIGENCE?

«The theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages.»

The Oxford Dictionary

AI IS TRANSFORMING INDUSTRIES







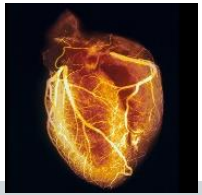

	CONSUMER	HEALTH	FINANCE	RETAIL	GOVERNMENT	ENERGY	TRANSPORT	INDUSTRIAL	OTHER
EXAMPLES	Smart Assistants Chatbots Search Personalization Augmented Reality Robots	Enhanced Diagnostics Drug Discovery Patient Care Research Sensory Aids	Algorithmic Trading Fraud Detection Research Personal Finance Risk Mitigation	Support Experience Marketing Merchandising Loyalty Supply Chain Security	Defense Data Insights Safety & Security Resident Engagement Smarter Cities	Oil & Gas Exploration Smart Grid Operational Improvement Conservation	Automated Cars Automated Trucking Aerospace Shipping Search & Rescue	Efficiency Improvement Factory Automation Predictive Maintenance Precision Agriculture Field Automation	Advertising Education Gaming Professional & IT Services Telco/Media Sports

EARLY ADOPTION

Source: Intel forecast

RECENT CUSTOMER EXAMPLES

HEALTH



Early Tumor Detection

Leading medical imaging company

↓

Early detection of malignant tumors in mammograms

↓

Millions of “Diagnosed” Mammograms

↓

Deep Learning (CNN) tumor image recognition

↓

Higher accuracy and earlier breast cancer detection

Personalized Care

Renowned US Hospital system

↓

Accurately diagnose fatal heart conditions

↓

10,000 health attributes used

↓

Saffron memory-based reasoning

↓

Increased accuracy to 94% compared with 54% for average cardiologist

FINANCE

Data Synthesis

Financial services institution with >$750B assets

↓

Parse info to reduce portfolio manager time to insight

↓

Vast stores of documents (news, emails, research, social)

↓

Deep Learning (RNN w/ encoder/decoder)

↓

Faster and more informed investment decisions

Customer Personalization

Leading Insurance Group

↓

Increase product recommendation accuracy

↓

5 Product Levels
1,353 Products
12M Members

↓

Saffron memory-based reasoning

↓

50% increase in product recommendation accuracy

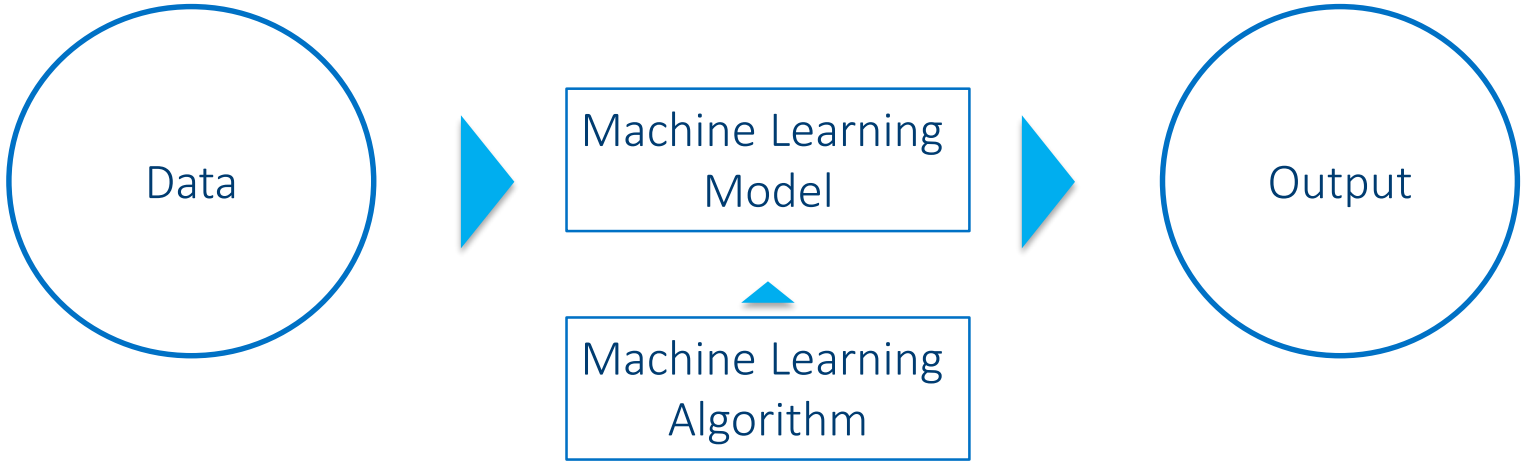
WHAT IS MACHINE LEARNING

WHAT IS MACHINE LEARNING?

«The field of study that gives computers the ability to learn without being explicitly programmed»

Arthur Samuel, 1959

THE MACHINE LEARNING PIPELINE



TRAINING DATA SET

In order to train the model, we need a **Training Dataset**. If we have dataset of 100,000 houses sold in Portland this year, we take 75-80% of the data to train the model.

TEST DATA SET

Remaining 20% of the Data - we hide it from the model. That will helps understanding how well the model will perform for new Data. That 20% is called a Test Dataset

FRAMEWORKS & LANGUAGES

An awesome list: https://github.com/josephmisiti/awesome-machine-learning

TYPES OF MACHINE LEARNING

Types of Machine Learning

Supervised Learning

Teach desired behavior with labeled data

Make sense of new data based on prior data

Unsupervised Learning

Make inferences without labeled data

Discover unknown or hidden patterns

Reinforcement Learning

Act in an environment to maximize reward

Build autonomous agents that learn

SUPERVISED LEARNING

WE FEED THE MODEL WITH CORRECT ANSWERS , THE MODEL LEARNS AND FINALLY PREDICTS.

WE FEED THE MODEL WITH “GROUND TRUTH”.

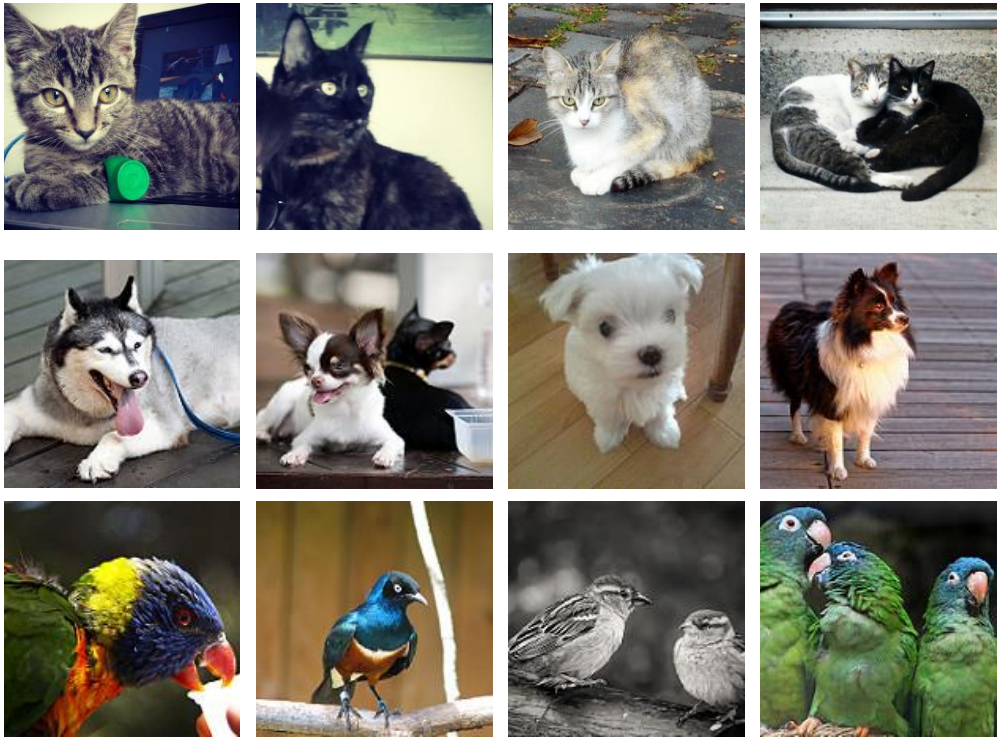
MACHINE LEARNING SOLUTIONS

CLASSIFICATION

Predicting a discrete value for an entity with a given set of features.

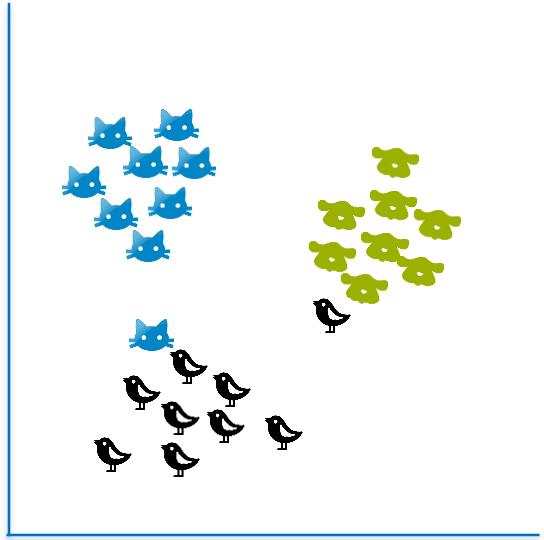
REGRESSION

CLASSIFICATION

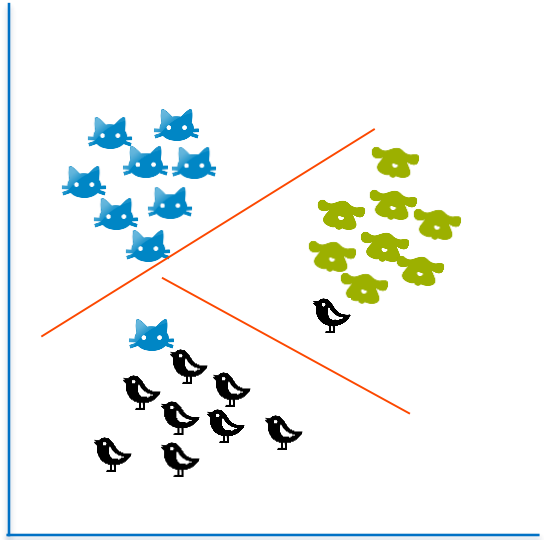


?

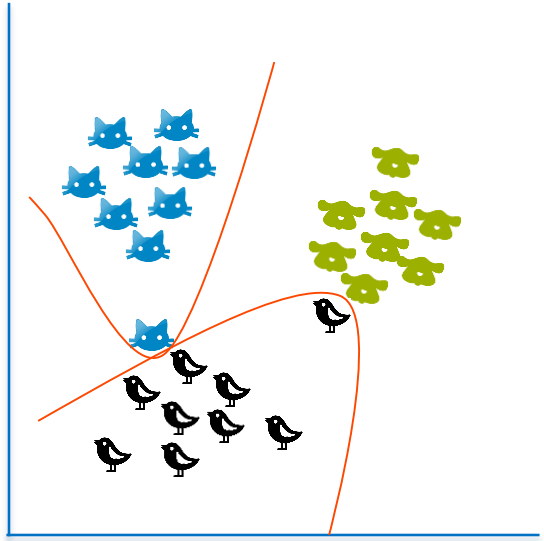
CLASSIFICATION



CLASSIFICATION



CLASSIFICATION



HANDS-ON WORK

Installing Anaconda, Scikit-Learn, Tensorflow & Jupyter

Installing Anaconda

Download Anaconda from https://www.continuum.io/downloads

Run the installer it:

Windows & Mac OS: double click

Linux:
```
cd Downloads
cmod u+x Anaconda3-4.4.0-Linux-x86_64.sh
./Anaconda3-4.4.0-Linux-x86_64.sh
```

Install Required Packages

conda update conda

conda config --add channels intel

conda create -n idp intelpython3_core python=3.5

activate idp (Windows)

source activate idp (Linux & Mac)

conda install numpy pandas scikit-learn tensorflow jupyter

Run Jupyter

jupyter notebook

http://localhost:8888/

HANDS-ON WORK

Case Study: Iris Dataset

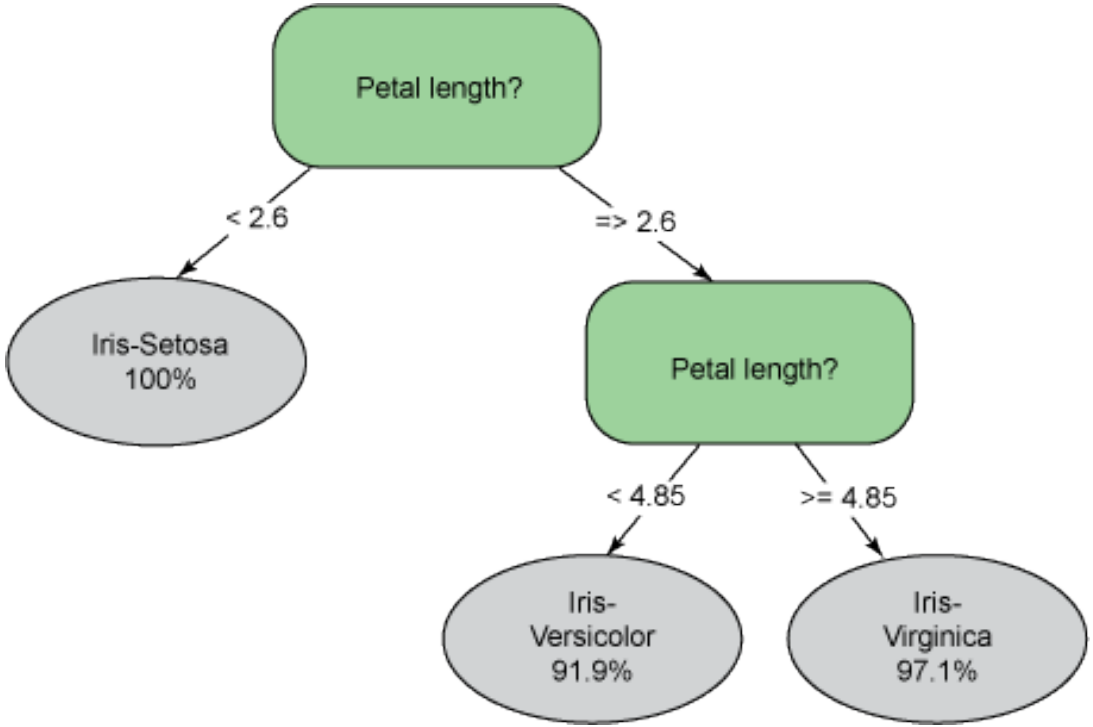
CASE STUDY: IRIS PLANTS

Iris Dataset:

The data set contains 3 classes of 50 instances each, where each class refers to a type of iris plant. One class is linearly separable from the other 2; the latter are NOT linearly separable from each other.

Number of Attributes: 4 (sepal length in cm, sepal width in cm, petal length in cm, petal width in cm)
Number of Instances: 150 (50 in each of three classes)
Target: Iris-Setosa, Iris-Versicolour, Iris-Virginica

DECISION TREES



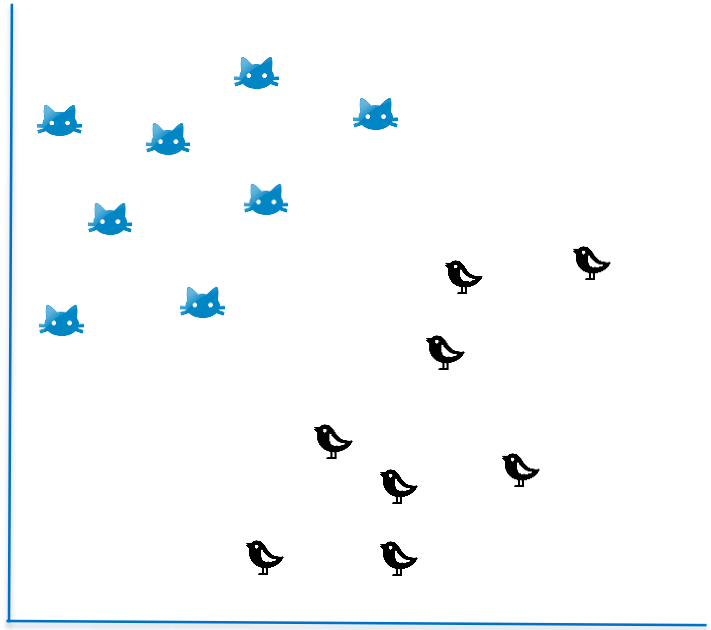
CASE STUDY: IRIS PLANTS

Decision Tree Classification

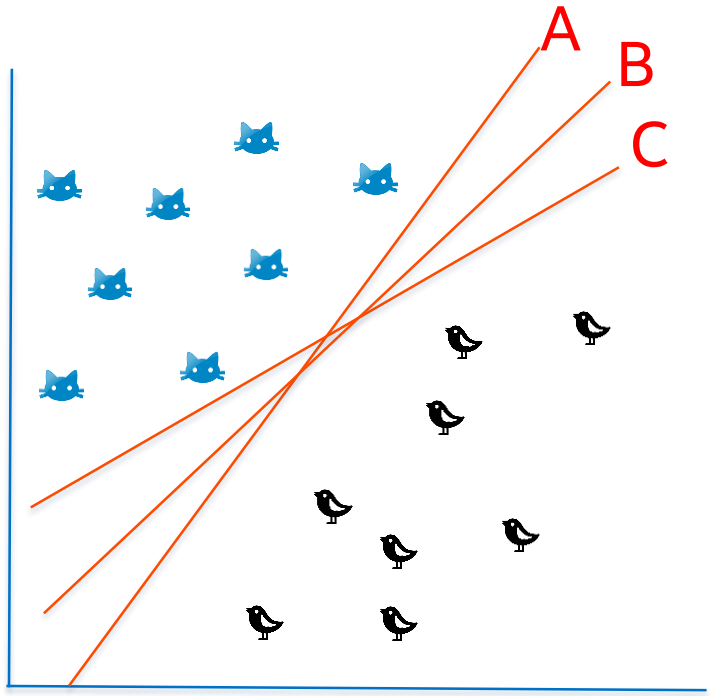
iPython notebook:

https://github.com/mstfldmr/IntelAIWorkshop/blob/master/DecisionTreeClassifier.ipynb

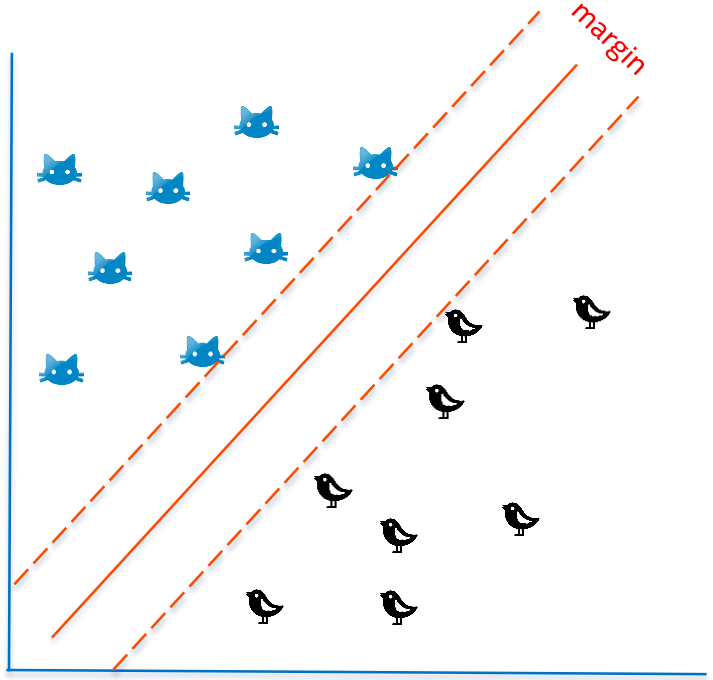
SUPPORT VECTOR MACHINES



SUPPORT VECTOR MACHINES

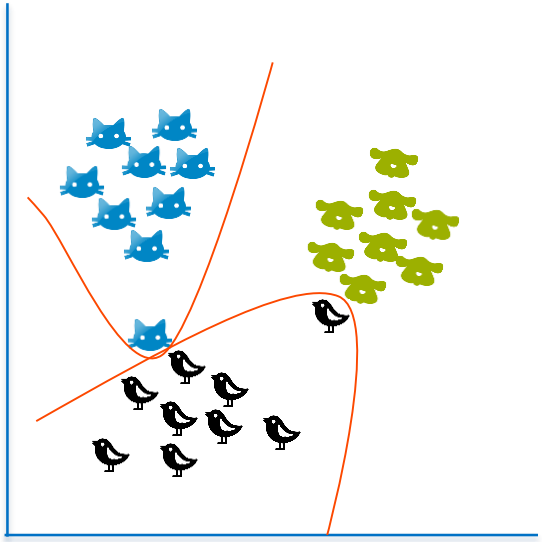


SUPPORT VECTOR MACHINES

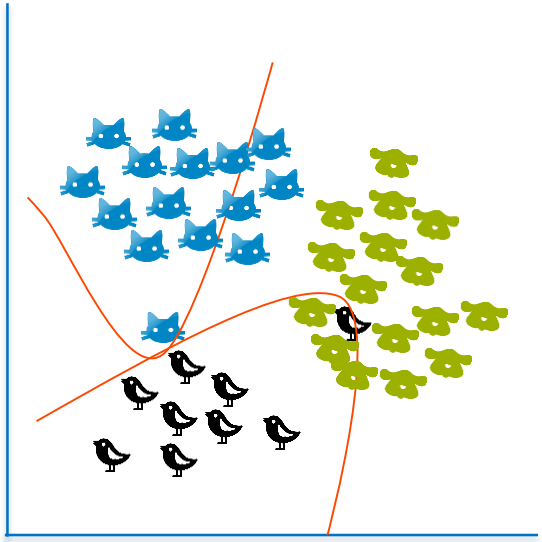


OVERFITTING

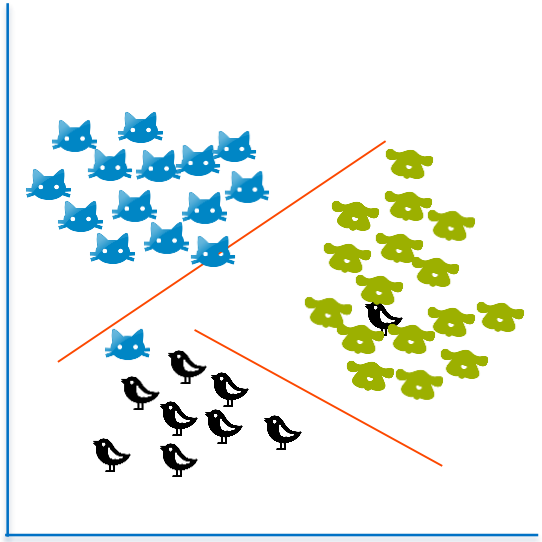
TRAINNING



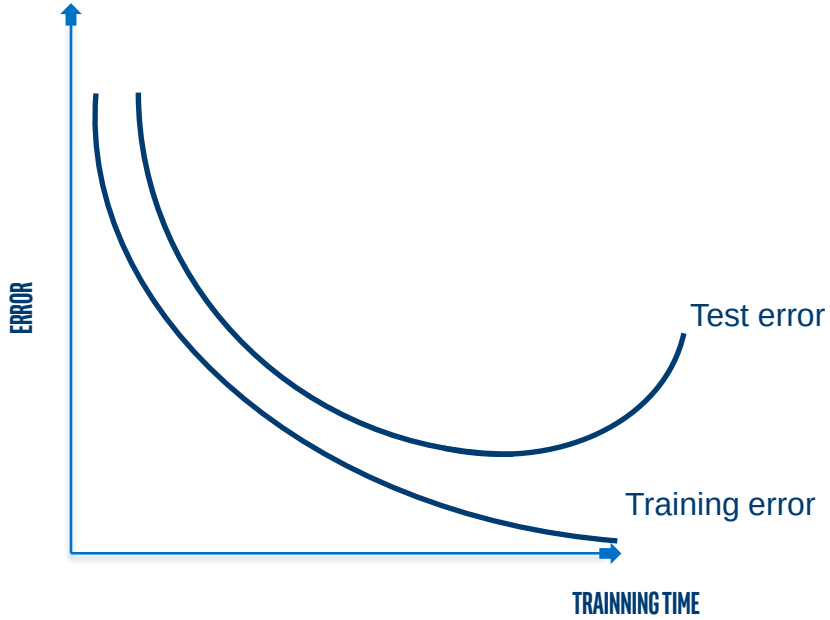
TESTING



TESTING



OVERFITTING

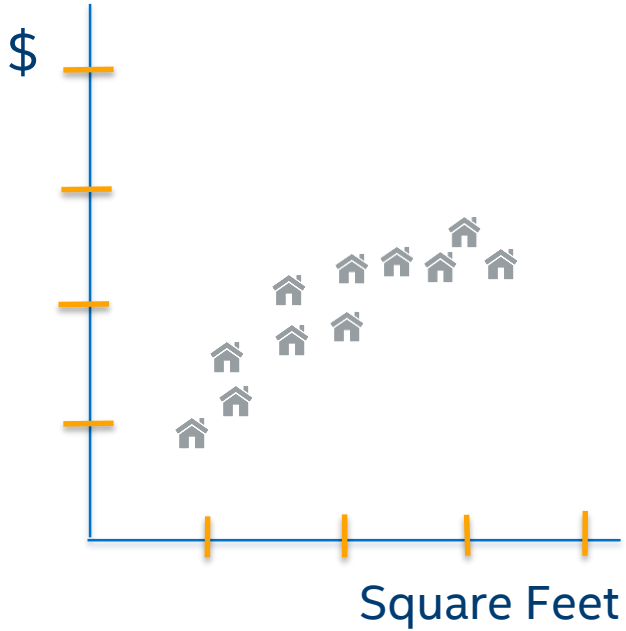


SUPERVISED LEARNING

CLASSIFICATION

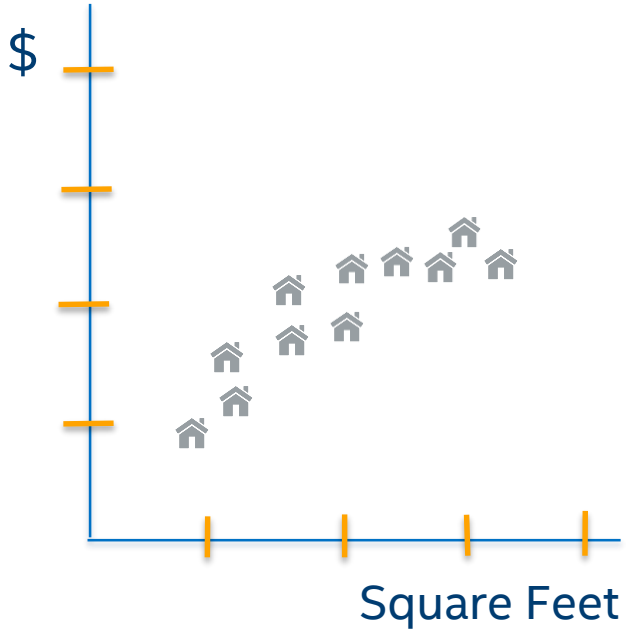
REGRESSION

Regression attempts to predict a real numeric value for an entity with a given set of features.



Set of Input vectors having a class or label

You train the model for predicting fair value of a house based on house attributes using historical home sales data. The model build can now predict the fair value of a new home.



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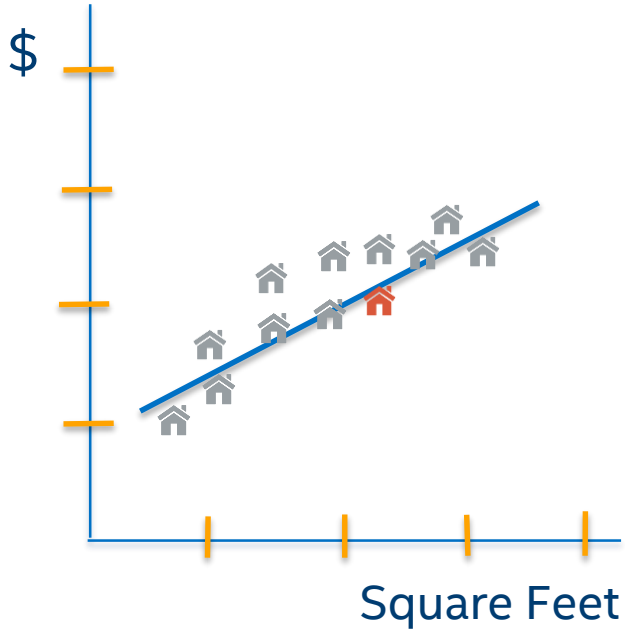


Classify New data point into one of the already known class

You train the model for predicting fair value of a house based on house attributes using historical home sales data. The model build can now predict the fair value of a new home.

HANDS-ON WORK

Case Study: Diabetes Dataset

CASE STUDY: DIABETES

Diabetes Dataset:

Ten baseline variables, age, sex, body mass index, average blood pressure, and six blood serum measurements were obtained for each of n = 442 diabetes patients, as well as the response of interest, a quantitative measure of disease progression one year after baseline.

Number of Attributes: 10
Number of Instances: 442
Target: Column 11 is a quantitative measure of disease progression one year after baseline

CASE STUDY: DIABETES

Linear Regression

iPython notebook:

https://github.com/mstfldmr/IntelAIWorkshop/blob/master/LinearRegression.ipynb

CASE STUDY: HOUSE SALES IN KING COUNTY, USA

id	date	price	bedrooms	bathrooms	sqft_living	...	grade	...
7129300520	20141013...	221900	3	1	1180		7	
6414100192	20141209...	538000	3	2.25	2570		7	
5631500400	20150225...	180000	2	1	770		6	
2487200875	20141209...	604000	4	3	1960		7	
...	...	...	...	...	...	...	...	...
1523300141	20140623...	402101	2	0.75	1020		7	
291310100	20150116...	400000	3	2.5	1600		8	
1523300157	20141015...	325000	2	0.75	1020		7	

Dataset and sample solutions: https://www.kaggle.com/harlfoxem/housesalesprediction

UNSUPERVISED LEARNING

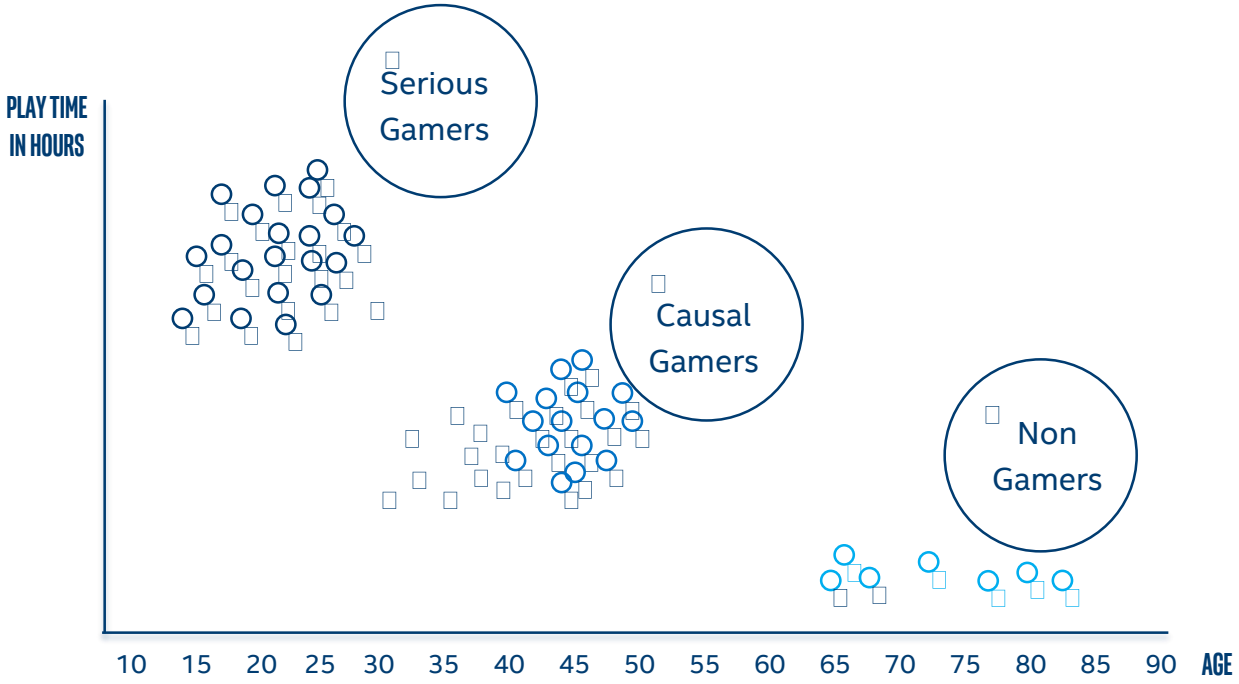
DATA IS GIVEN TO THE MODEL. RIGHT ANSWERS ARE NOT PROVIDED TO THE MODEL. THE MODEL MAKES SENSE OF THE DATA GIVEN TO IT.

UNSUPERVISED LEARNING

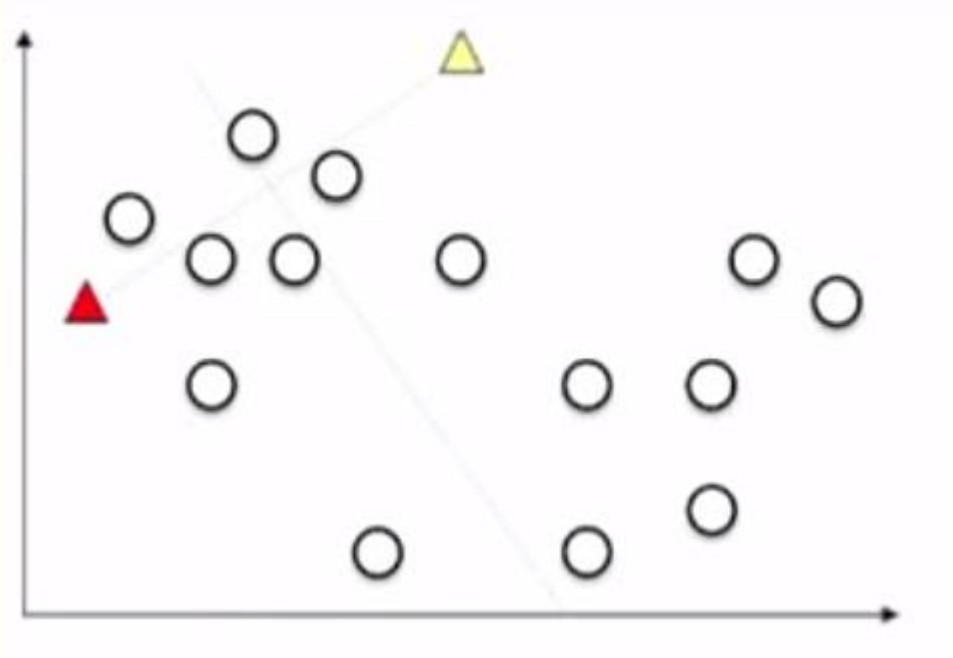
CLUSTERING

Grouping entities with similar features.
Unsupervised learning.

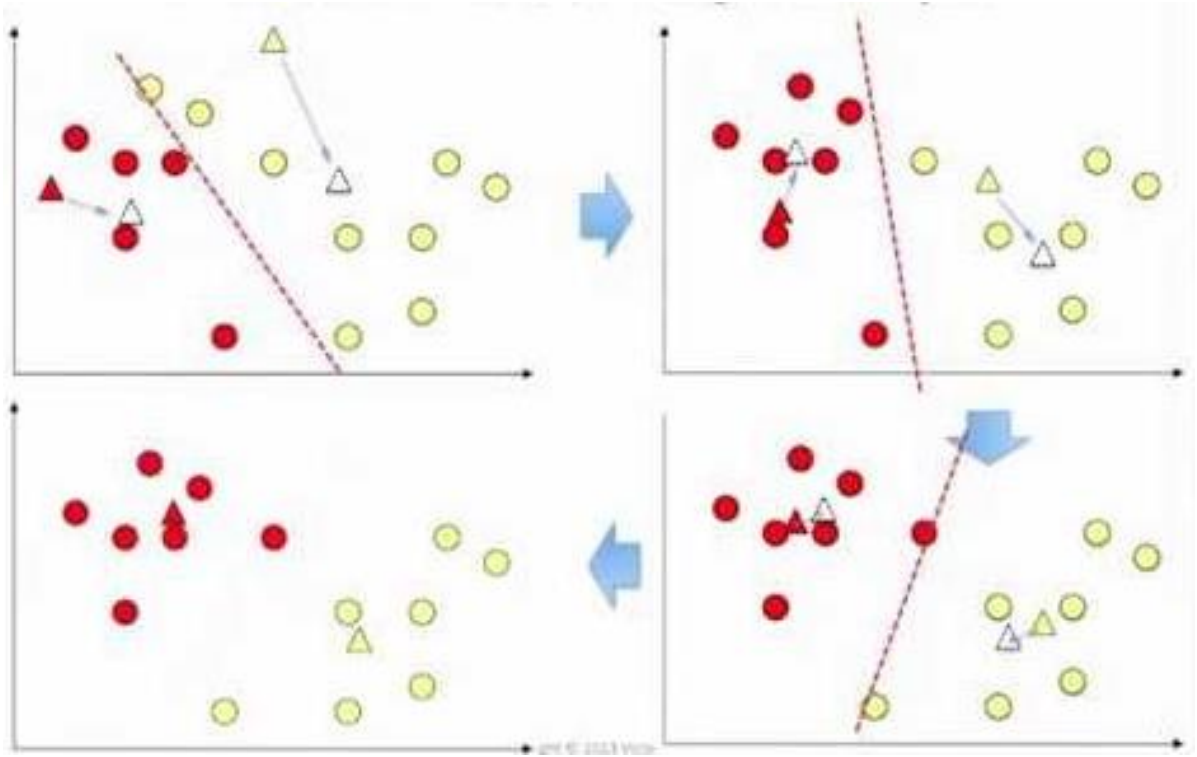
CLUSTERING EXAMPLE: MARKET SEGMENTATION



K-MEANS CLUSTERING



K-MEANS CLUSTERING



HANDS-ON WORK

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CASE STUDY: IRIS PLANTS

K-Means Clustering

iPython notebook:

https://github.com/mstfldmr/IntelAIWorkshop/blob/master/KMeansClustering.ipynb

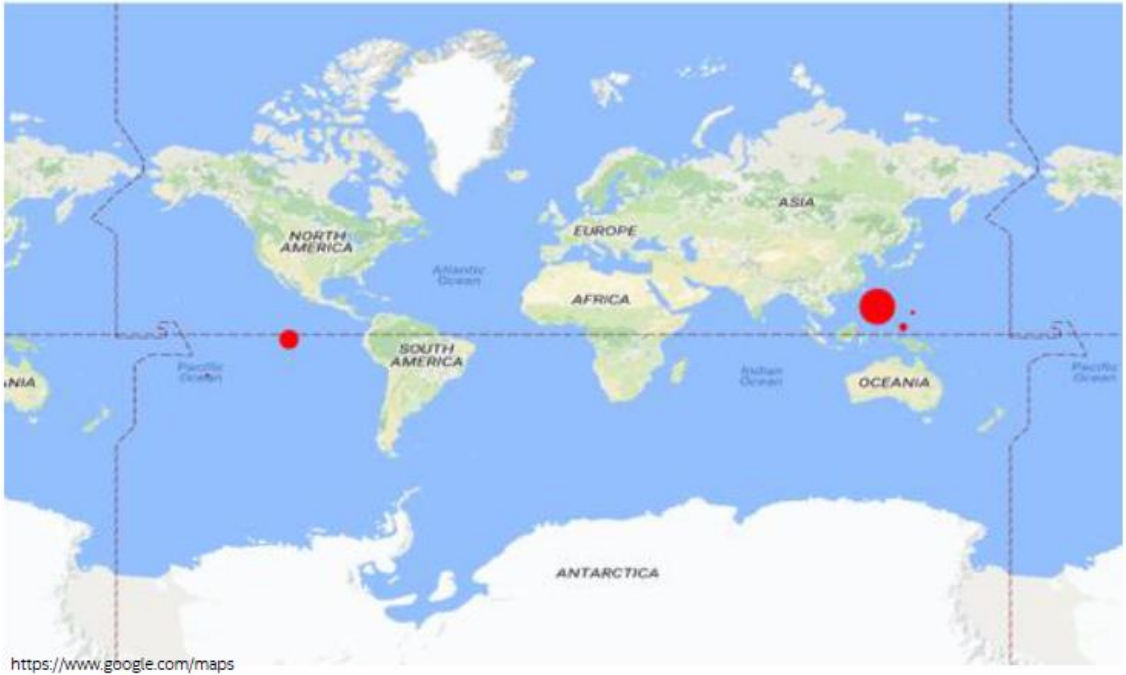
https://github.com/mstfldmr/IntelAIWorkshop/blob/master/KMeansClustering2.ipynb

CASE STUDY: SIGNIFICANT EARTHQUAKES, 1965-2016

Date	Time	Latitude	Longitude	Type	Depth	...	Magnitude	...
1/2/1965	13:44:18	19.246	145.616	Earthquake	131.6		6	
1/4/1965	11:29:49	1.863	127.352	Earthquake	80		5.8	
1/5/1965	18:05:58	-20.579	-173.972	Earthquake	20		6.2	
1/8/1965	18:49:43	-59.076	-23.557	Earthquake	15		5.8	
...	...	...	...	...	...	...	...	...
12/28/2016	12:38:51	36.9179	140.4262	Earthquake	10		5.9	
12/29/2016	22:30:19	-9.0283	118.6639	Earthquake	79		6.3	
12/30/2016	20:08:28	37.3973	141.4103	Earthquake	11.94		5.5	

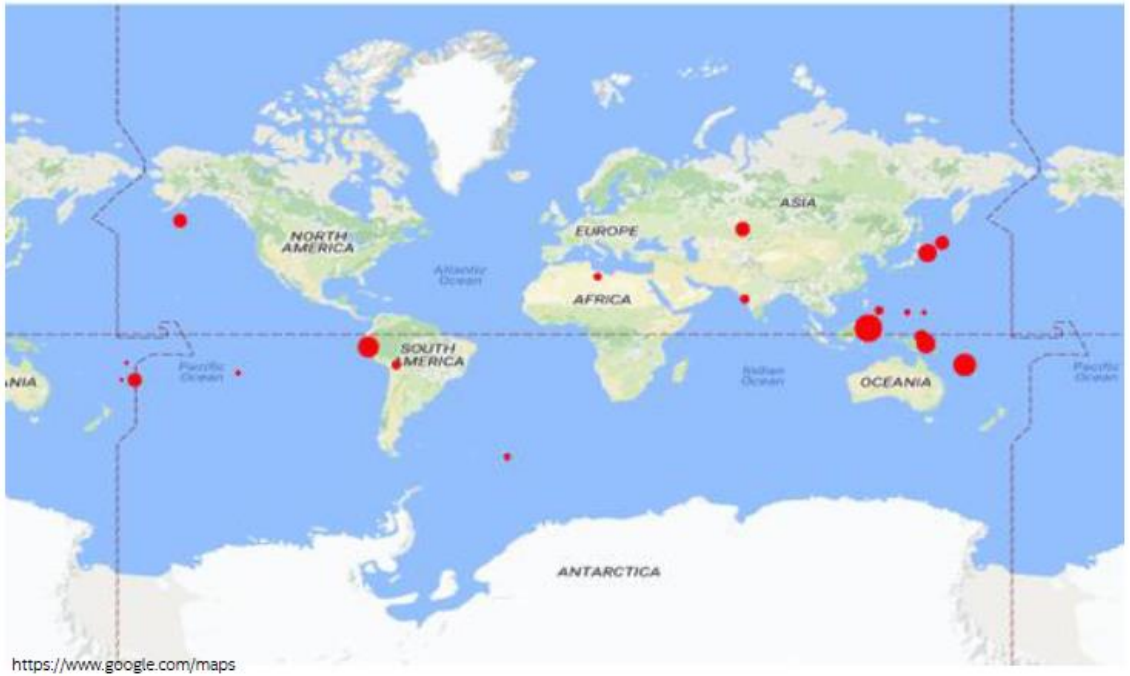
Dataset and sample solutions: https://www.kaggle.com/usgs/earthquake-database

CASE STUDY: SIGNIFICANT EARTHQUAKES, 1965-2016



5 Clusters

CASE STUDY: SIGNIFICANT EARTHQUAKES, 1965-2016



20 Clusters

CASE STUDY: SIGNIFICANT EARTHQUAKES, 1965-2016

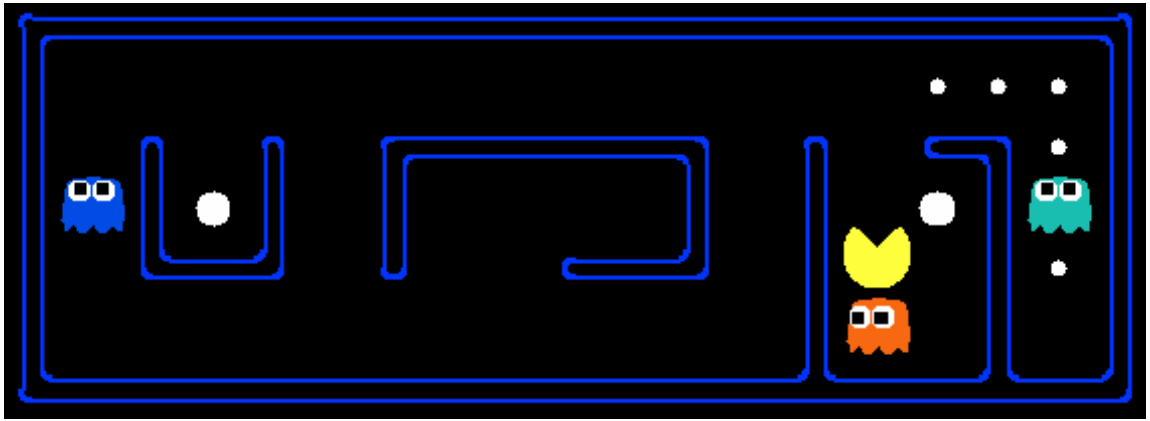
50 Clusters

REINFORCEMENT LEARNING

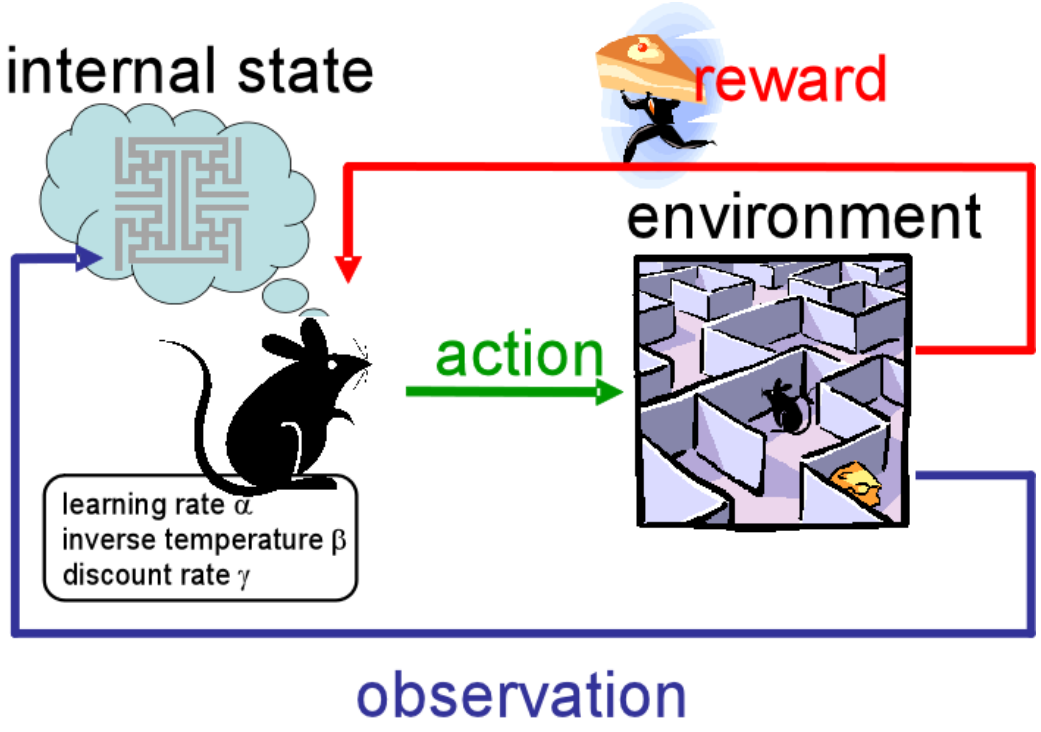
REINFORCEMENT LEARNING IS THE PROBLEM OF GETTING AN AGENT TO ACT IN THE WORLD SO AS TO MAXIMIZE ITS REWARDS.

REINFORCEMENT LEARNING

- Robotics
- Healthcare
- Smart cities

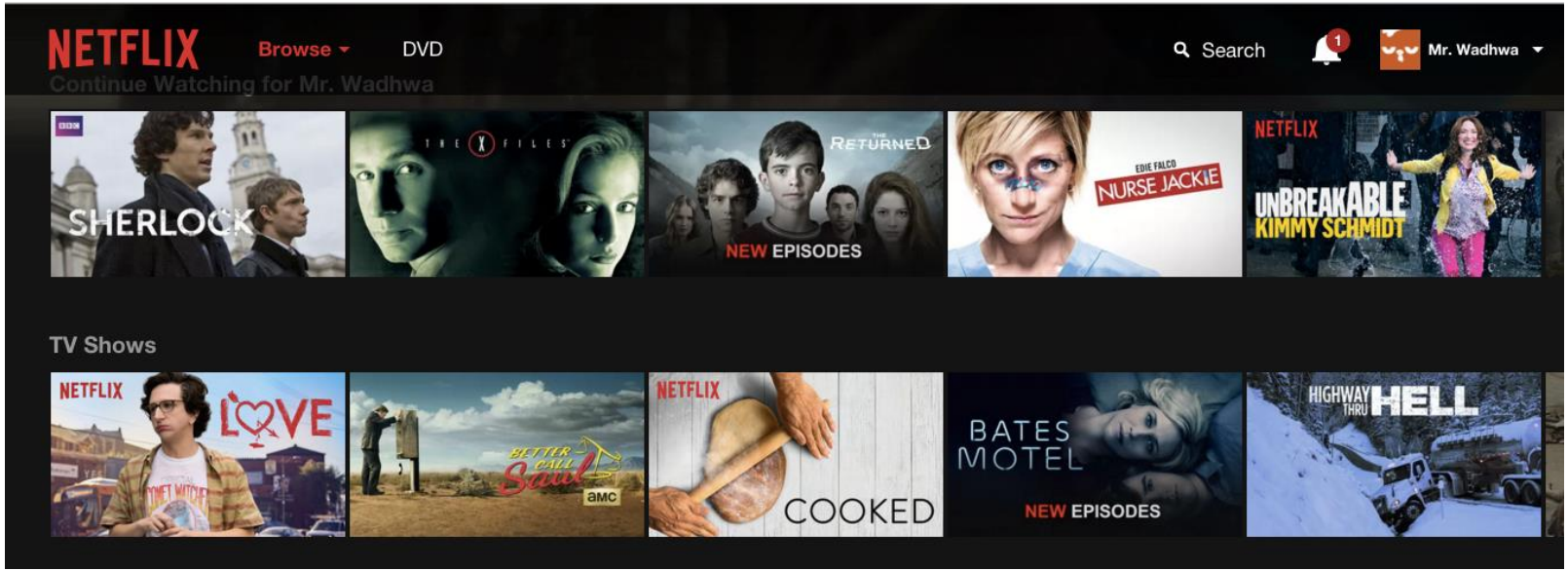


REINFORCEMENT LEARNING



CASE STUDY: RECOMMENDATION SYSTEMS

NETFLIX


NETFLIX
Browse
DVD
Search
1
Mr. Wadhwa
Continue Watching for Mr. Wadhwa
SHERLOCK
THE X FILES
THE RETURNED
NEW EPISODES
EDIE FALCO
NURSE JACKIE
NETFLIX
UNBREAKABLE KIMMY SCHMIDT
TV Shows
NETFLIX
LOVE
BETTER CALL Saul
AMC
NETFLIX
COOKED
BATES MOTEL
NEW EPISODES
HIGHWAY THRU HELL

- How does the Netflix Movie recommendation system work?
- How do they know what to recommend to Nancy and what to recommend to John?
- There is 170TB of Movies Data!

Nancy =
[5.04, 2.5, 0.02, 1.40, 1.10,...]
action, drama, romance, horror, tragedy,...

Netflix knows about Nancy.

Movie 1=
[3.24, 3.44, 0.12, 1.22, 0.10,...]
action, drama, romance, horror, tragedy,...

Movie 2=
[9.91, 1.5, 1.02, 1.10, 1.20,...]
action, drama, romance, horror, tragedy,...

Movie 3=
[1.04, 2.5, 9.02, 1.23, 1.30,...]
action, drama, romance, horror, tragedy,...

Which movie would you recommend to Nancy? Movie 1 , Movie 2 or Movie 3.

Let’s do simple math: Vector Multiplication.

	Action	Drama	Romance	Horror	Tragedy	Score
Nancy	5.04	2.5	0.02	1.40	1.10	
Movie 1	3.24	3.44	0.12	1.22	0.10	26.75
Movie 2	9.91	1.5	1.02	1.10	1.20	56.57
Movie 3	1.04	2.5	9.02	1.23	1.30	14.82

Q&A

Software

STUDENT DEVELOPER PROGRAM