



# 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 Hot is this Market?

## JOBS

9,433

LinkedIn Jan 2017

11,127

Indeed Jan 2017



**Pedro Domingos**  
@pmddomingos

Follow

No. of open positions for deep learning experts, according to Gartner: 41,000.  
No. of deep learning experts, according to Yoshua Bengio: 50.

RETWEETS  
257

LIKES  
444



9:45 PM - 14 May 2017

9

257

444

<https://index.co/market/machine-learning/acquisitions>

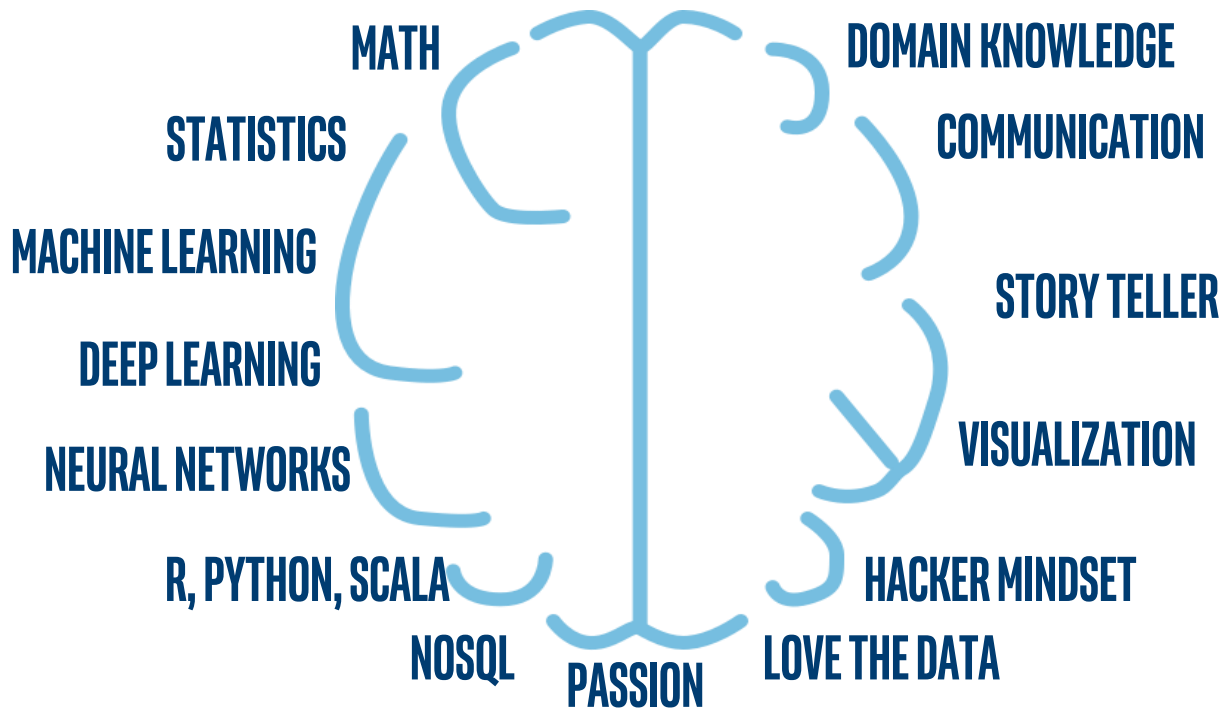


ARTIFICIAL  
INTELLIGENCE

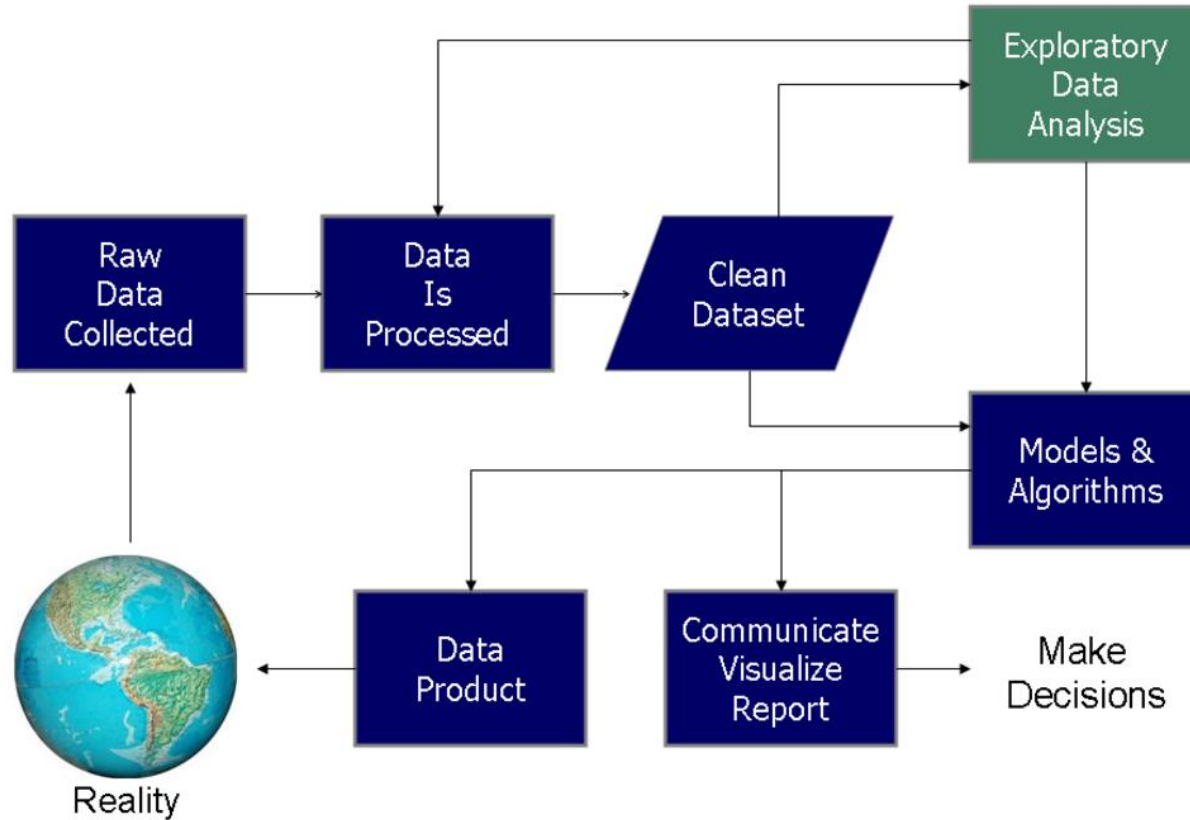


STUDENT DEVELOPER PROGRAM

# HOW TO BECOME A DATA SCIENTIST?



# The Data Science Process



Source: [https://en.wikipedia.org/wiki/Data\\_science](https://en.wikipedia.org/wiki/Data_science)

# DAILY DATA GENERATION IN 2020



1.5GB



3,000GB



4,000GB



40,000GB

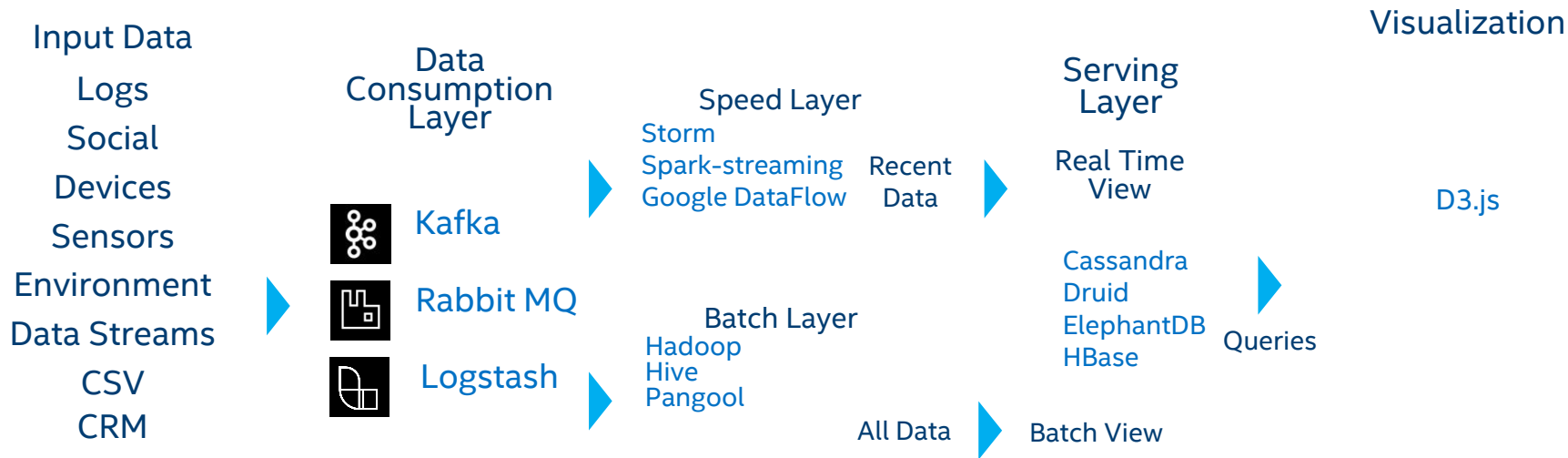


1,000,000GB





# 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

Smart Assistants  
Chatbots  
Search  
Personalization  
Augmented Reality  
Robots



## HEALTH

Enhanced Diagnostics  
Drug Discovery  
Patient Care  
Research  
Sensory Aids



## FINANCE

Algorithmic Trading  
Fraud Detection  
Research  
Personal Finance  
Risk Mitigation



## RETAIL

Support  
Experience  
Marketing  
Merchandising  
Loyalty  
Supply Chain  
Security



## GOVERNMENT

Defense  
Data Insights  
Safety & Security  
Resident Engagement  
Smarter Cities



## ENERGY

Oil & Gas Exploration  
Smart Grid  
Operational Improvement  
Conservation



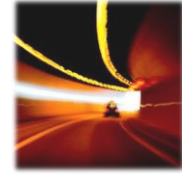
## TRANSPORT

Automated Cars  
Automated Trucking  
Aerospace  
Shipping  
Search & Rescue



## INDUSTRIAL

Efficiency Improvement  
Factory Automation  
Predictive Maintenance  
Precision Agriculture  
Field Automation



## OTHER

Advertising  
Education  
Gaming  
Professional & IT Services  
Telco/Media  
Sports

EXAMPLES

EARLY ADOPTION

Source: Intel forecast



ARTIFICIAL  
INTELLIGENCE

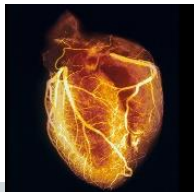
intel  
Software

STUDENT DEVELOPER PROGRAM

# 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



### 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

## FINANCE



### 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

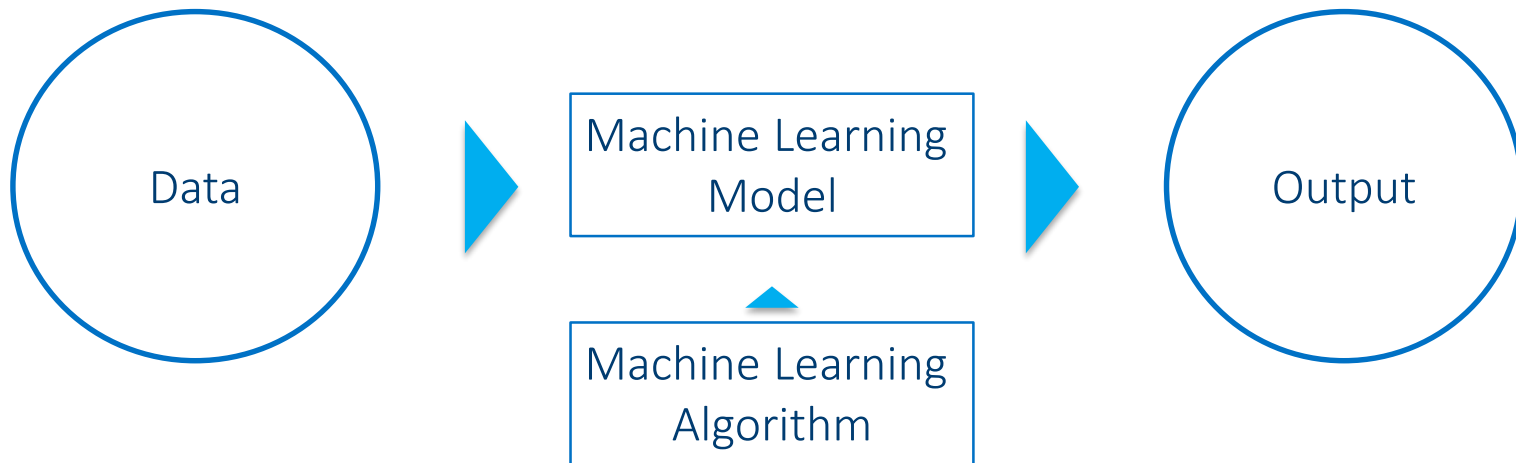
# WHAT IS MACHINE LEARNING?

«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 80% of the data to train the model.



# TEST DATA SET

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

# FRAMEWORKS & LANGUAGES

## Top Frameworks



## Programming languages



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





# TYPES OF MACHINE LEARNING

# Types of Machine Learning

## Supervised Learning

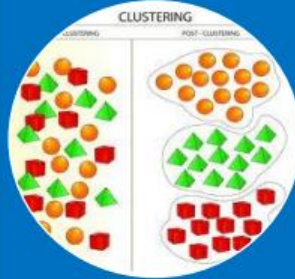
Teach desired behavior with labeled data



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

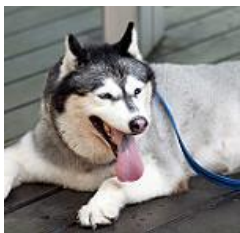
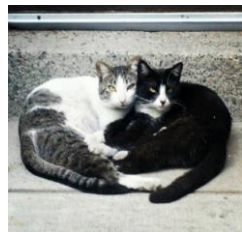
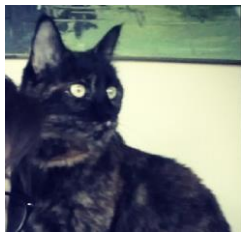
Predicting a discrete value for an entity with a given set of features.

## REGRESSION

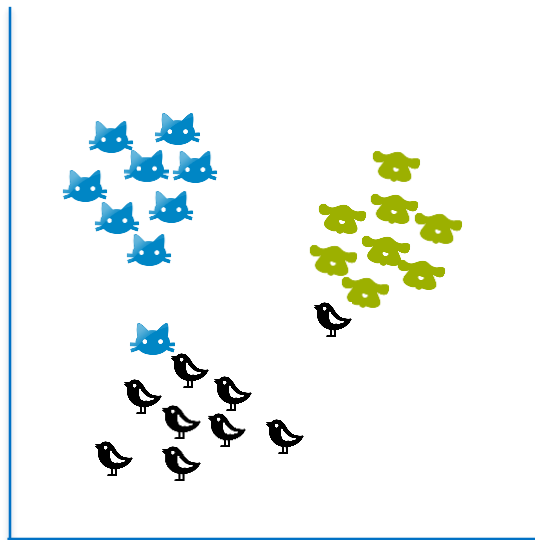
## CLUSTERING



# CLASSIFICATION

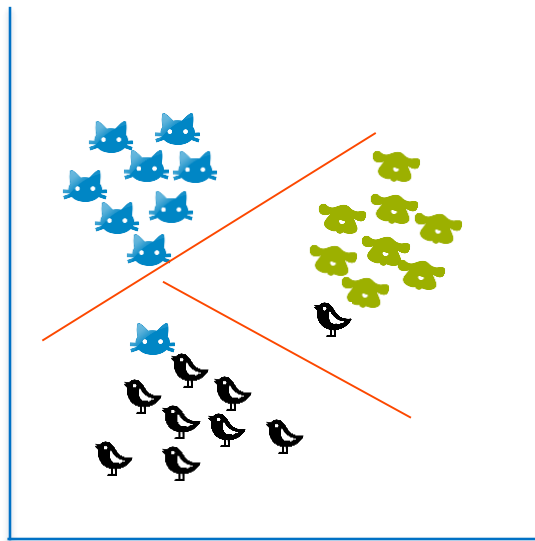


# CLASSIFICATION

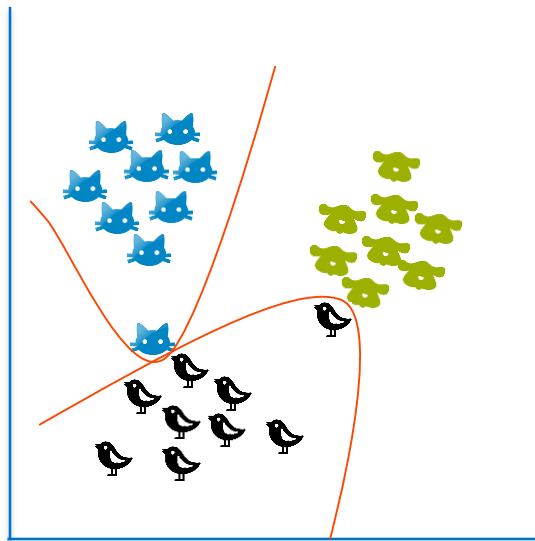




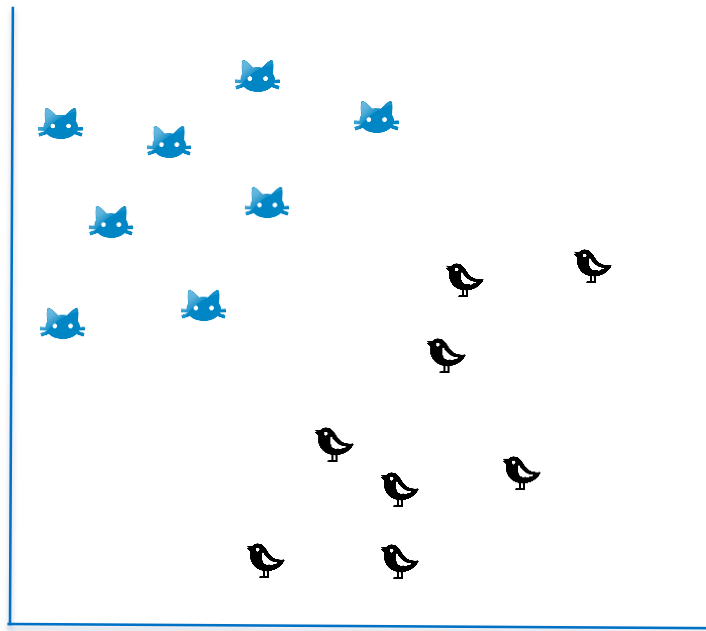
# CLASSIFICATION



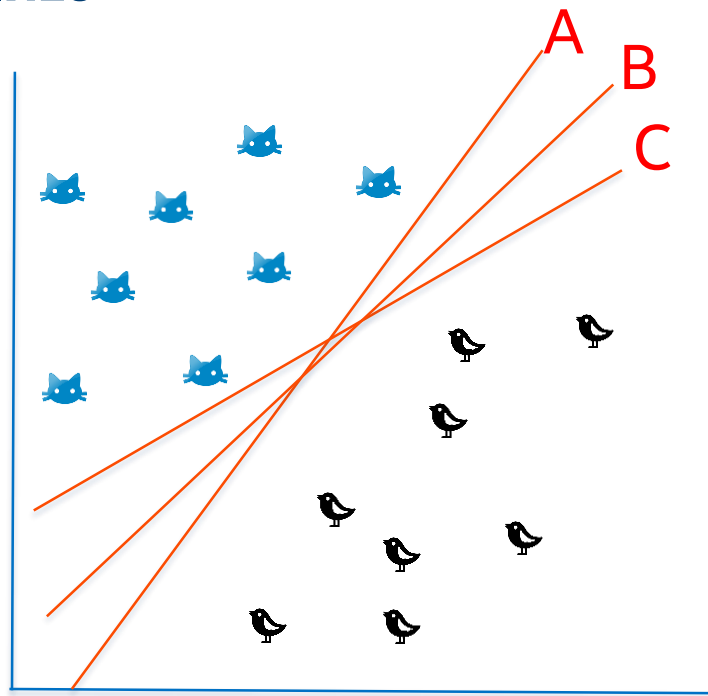
# CLASSIFICATION



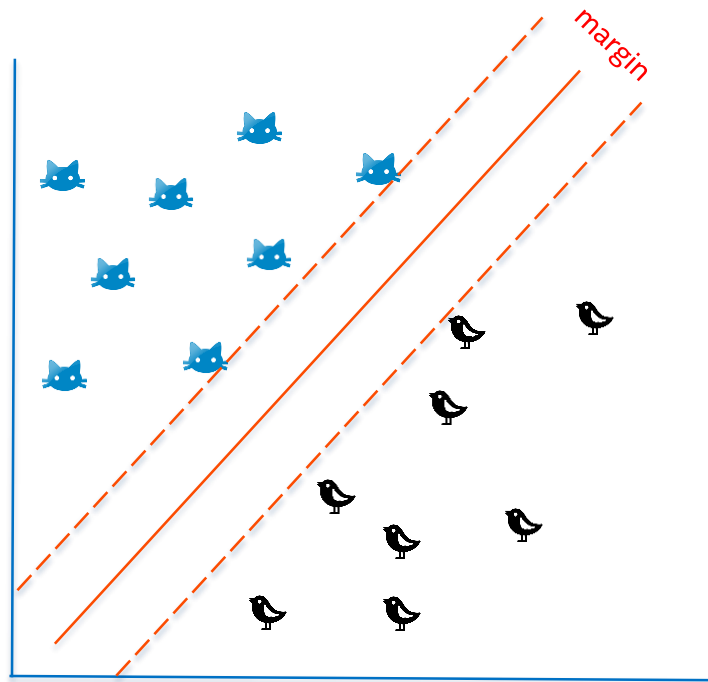
# SUPPORT VECTOR MACHINES



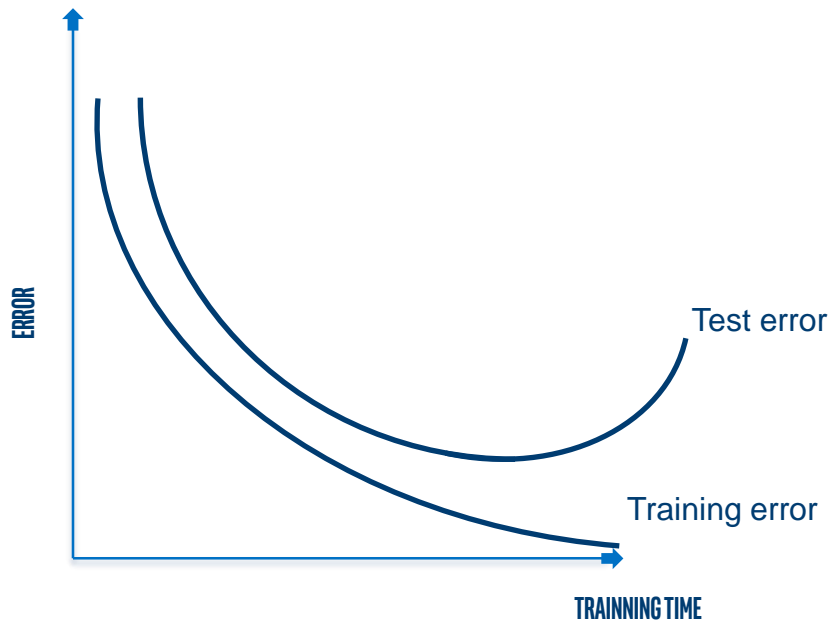
# SUPPORT VECTOR MACHINES



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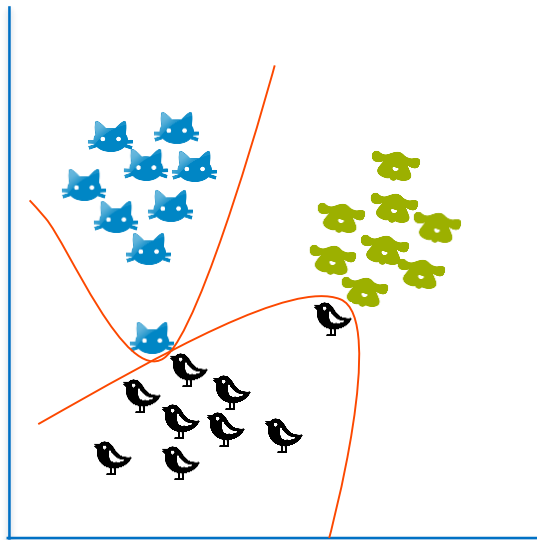


# OVERFITTING

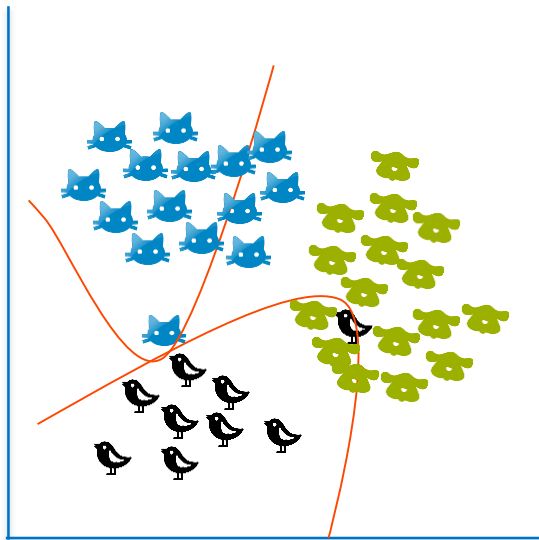


# OVERFITTING

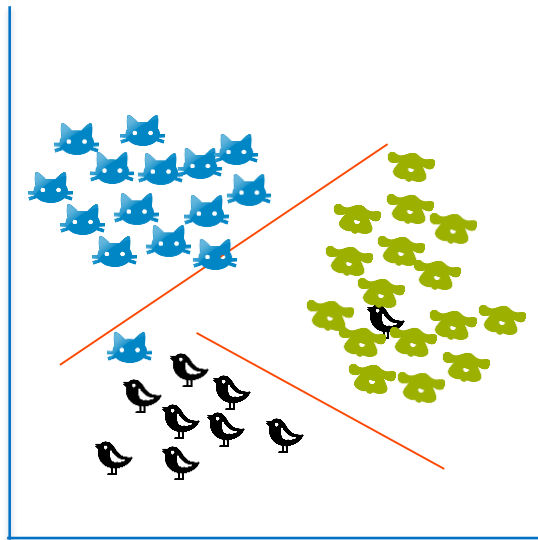
TRAINING



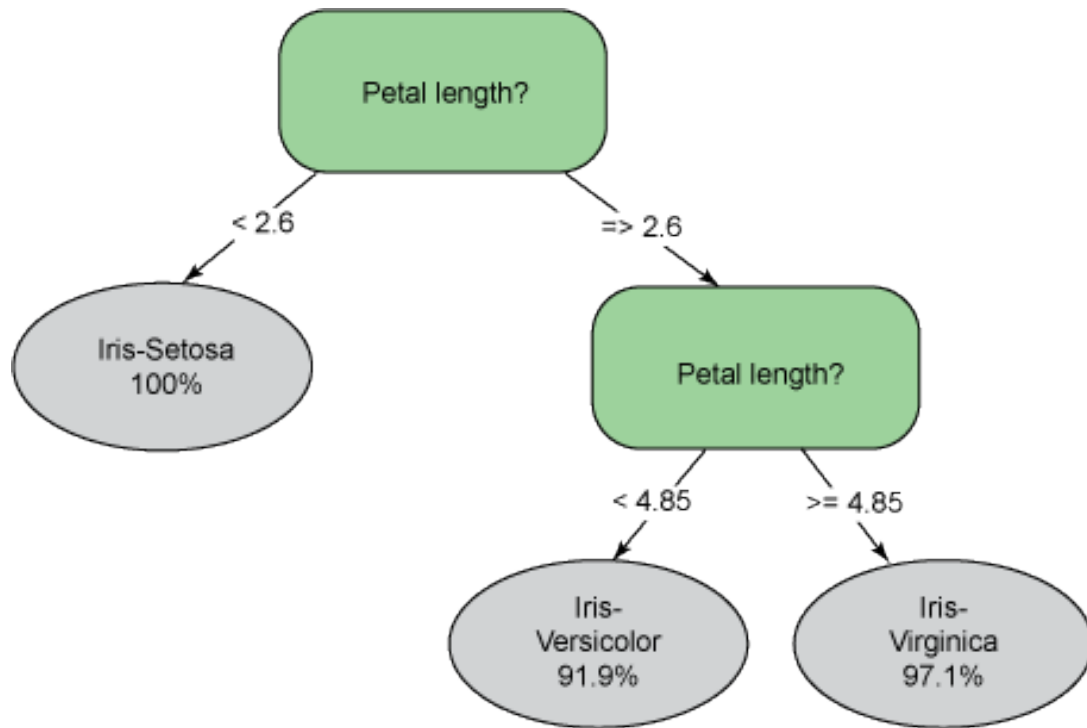
TESTING



TESTING



# DECISION TREES





# 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

# CASE STUDY: IRIS PLANTS

## K-Means Clustering

### iPython notebook:

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

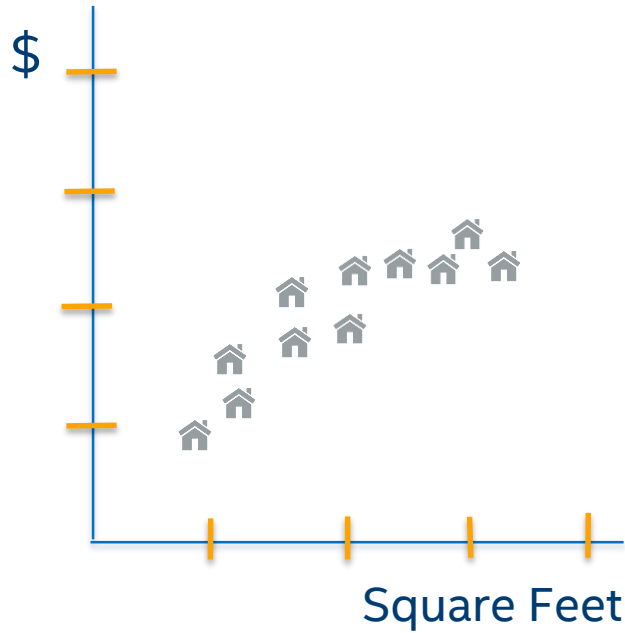
# MACHINE LEARNING SOLUTIONS

CLASSIFICATION

REGRESSION

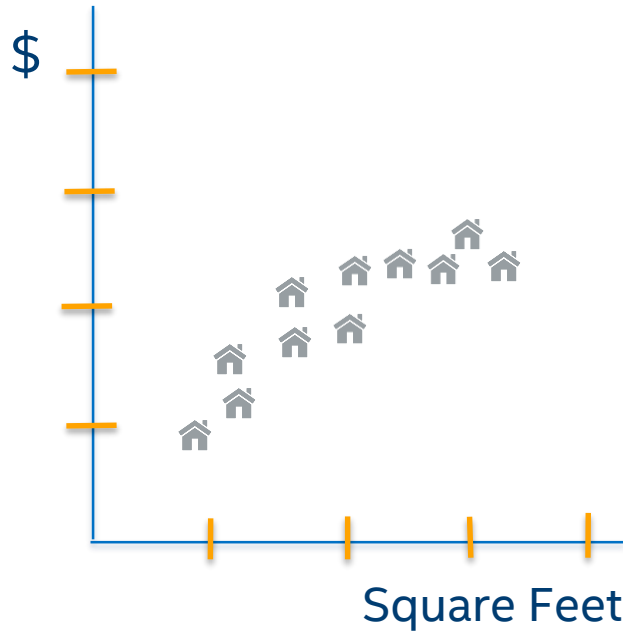
Regression attempts to predict a real numeric value for an entity with a given set of features.

CLUSTERING

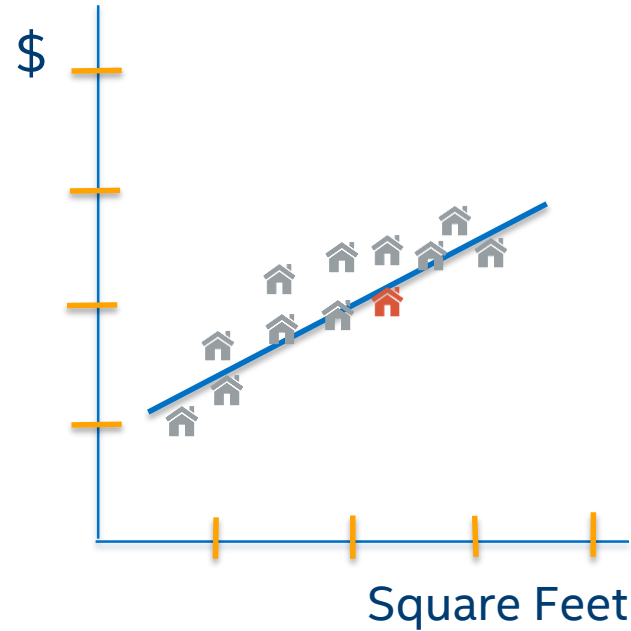


Set of Input vectors having a class or label

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.



Set of Input vectors having a class or label



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.

# 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>

## 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.**





# MACHINE LEARNING SOLUTIONS

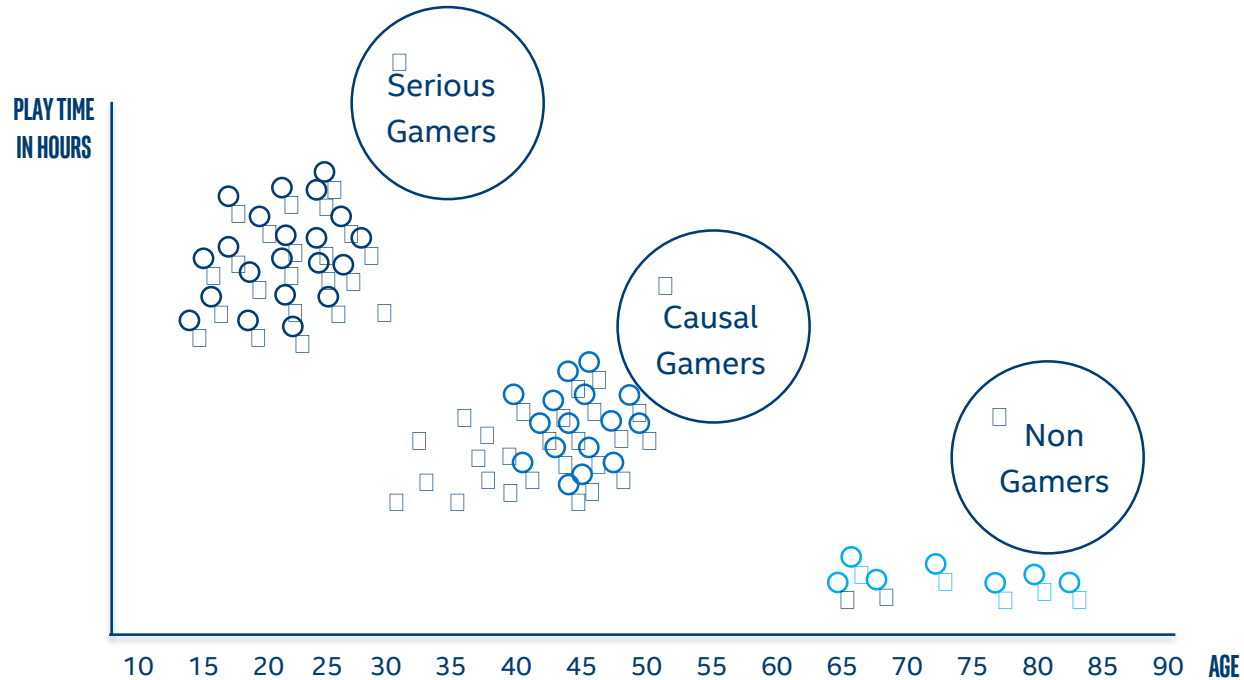
CLASSIFICATION

REGRESSION

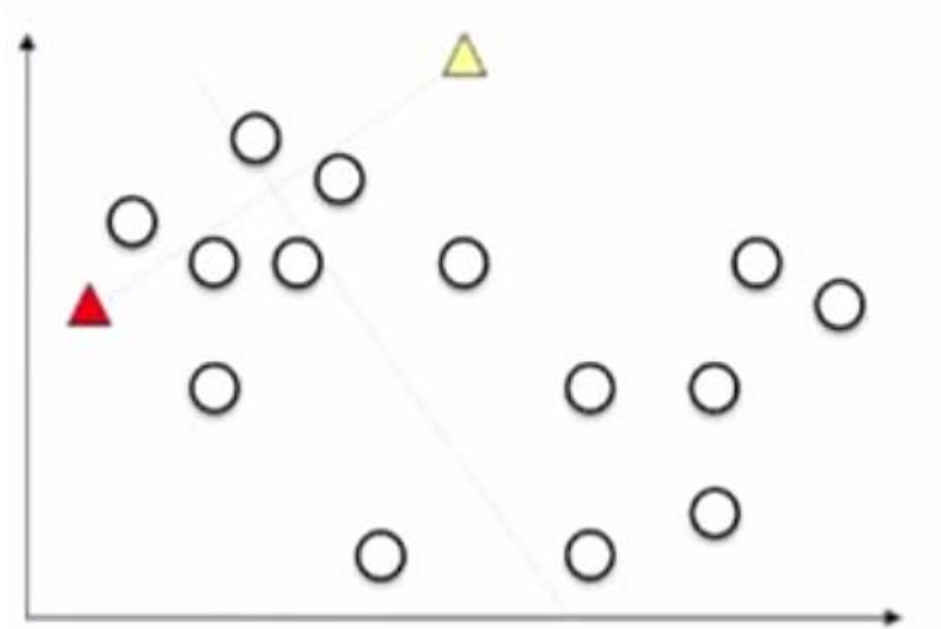
**CLUSTERING**

Grouping entities with similar features.  
Unsupervised learning.

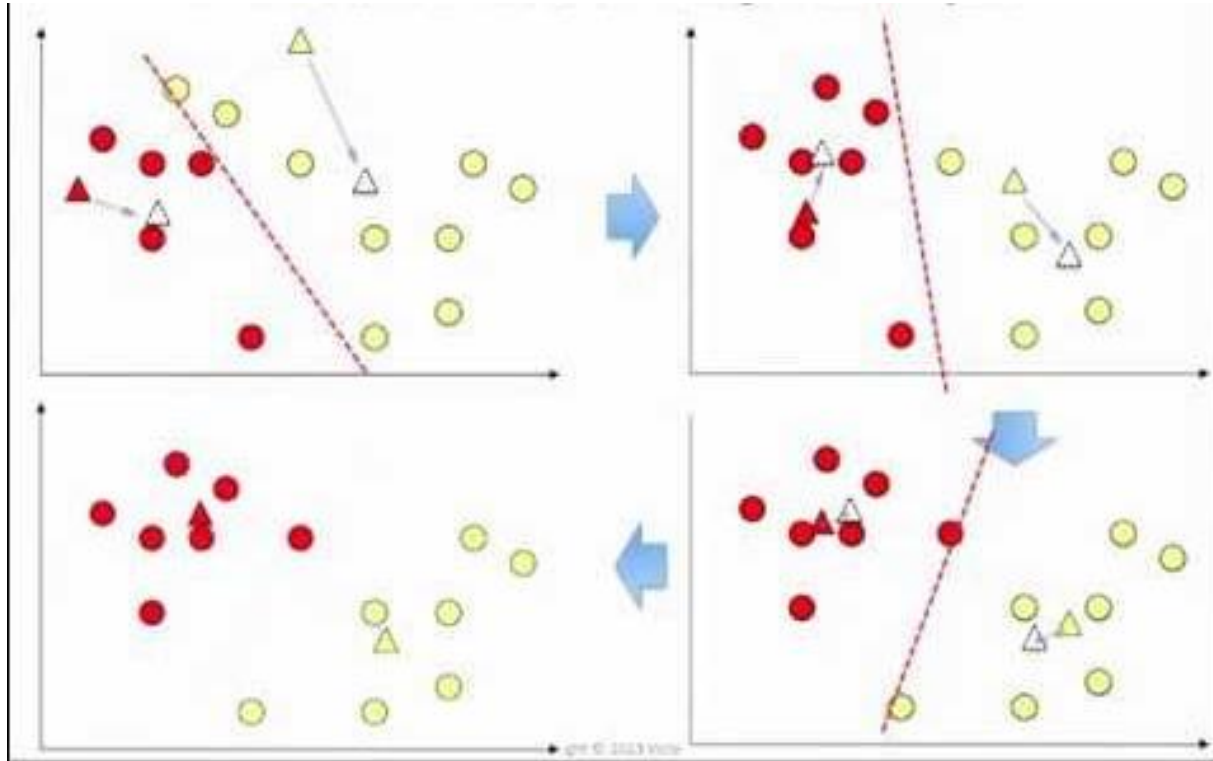
# CLUSTERING EXAMPLE: MARKET SEGMENTATION



# K-MEANS CLUSTERING



# K-MEANS CLUSTERING



# CASE STUDY: IRIS PLANTS

## Iris Dataset:

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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>

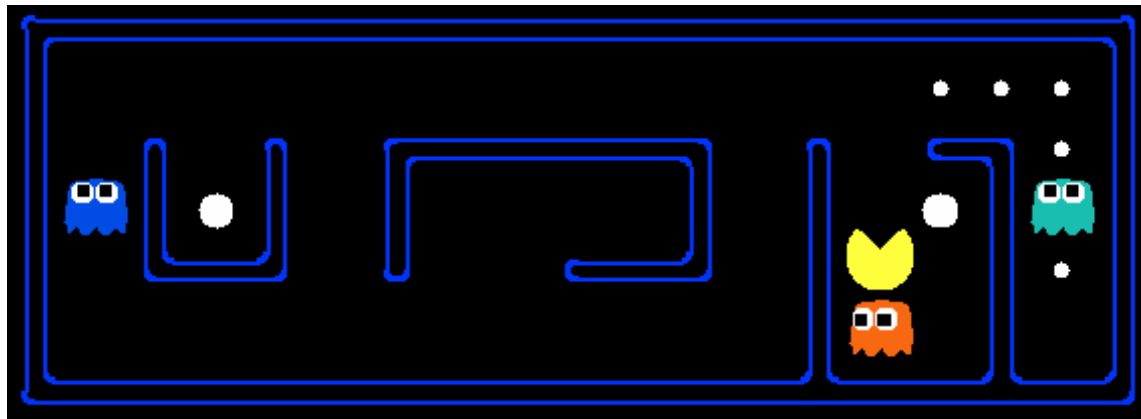
# REINFORCEMENT LEARNING

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



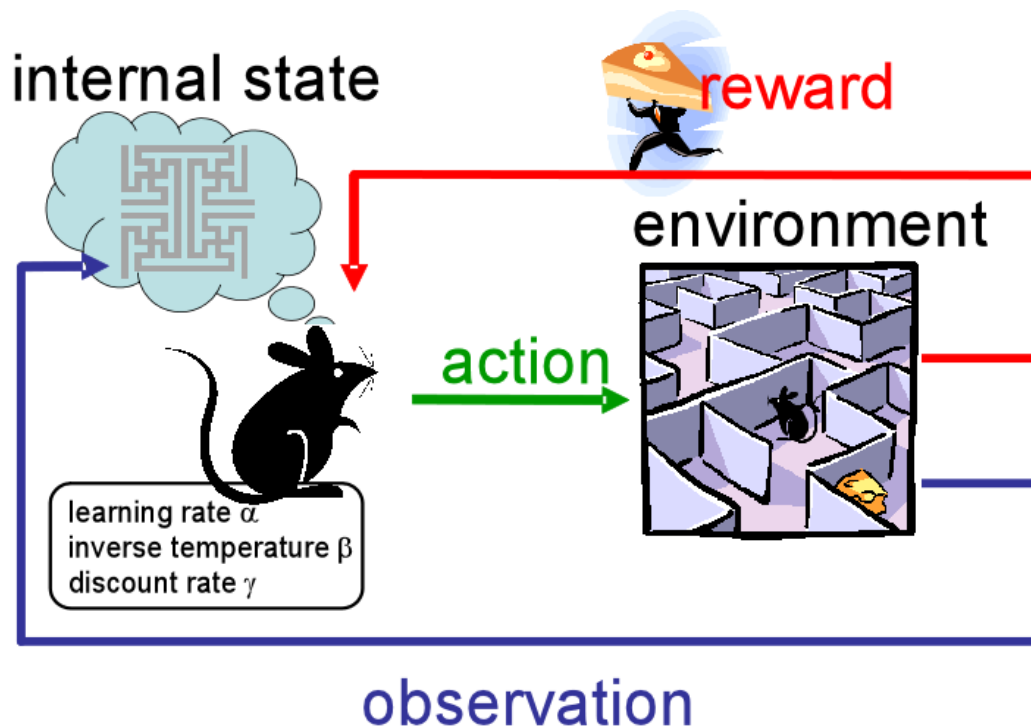
# REINFORCEMENT LEARNING

- Robotics
- Healthcare
- Smart cities



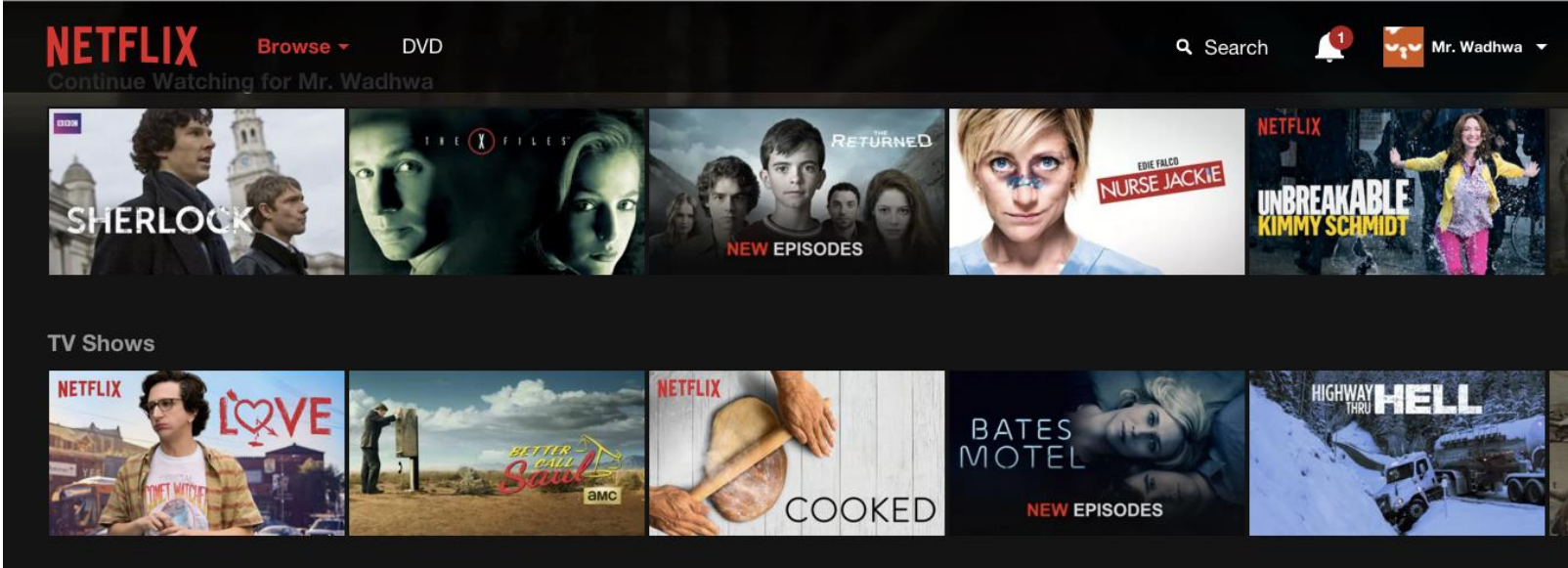


# REINFORCEMENT LEARNING



# CASE STUDY: RECOMMENDATION SYSTEMS







- 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.**

# NETFLIX

	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