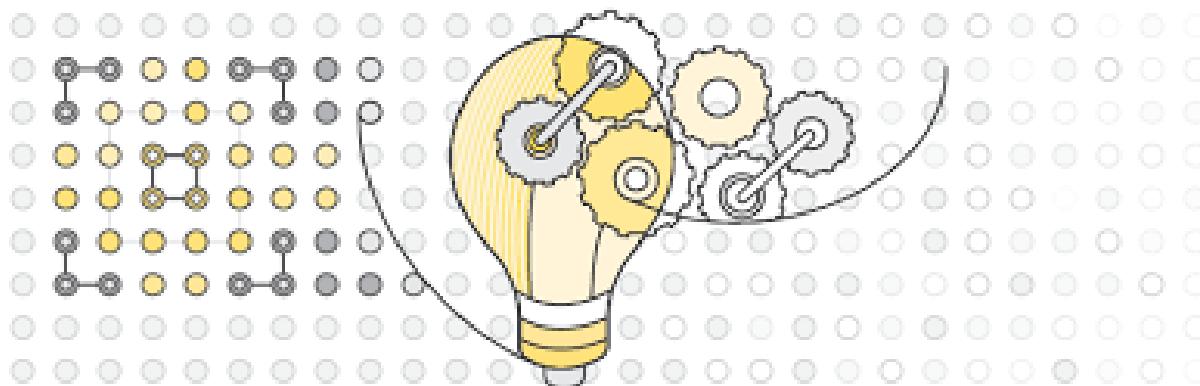
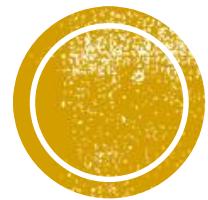
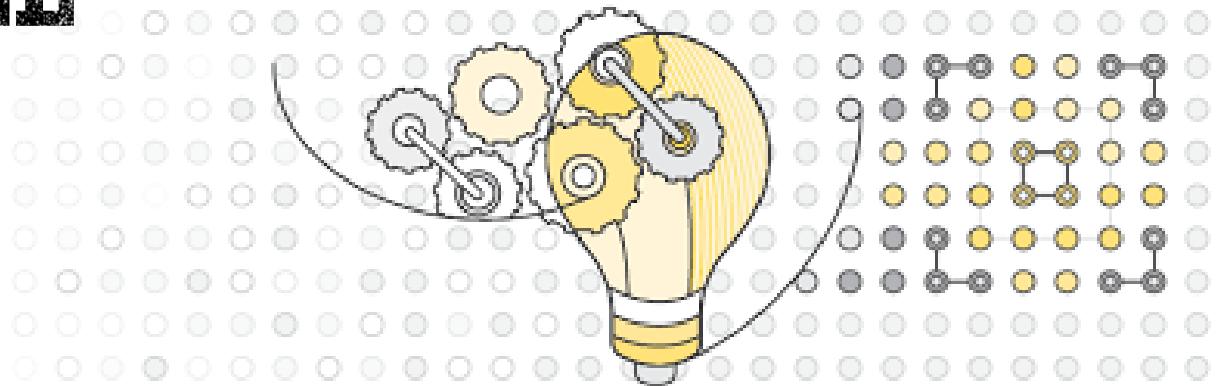


INTRODUCTION





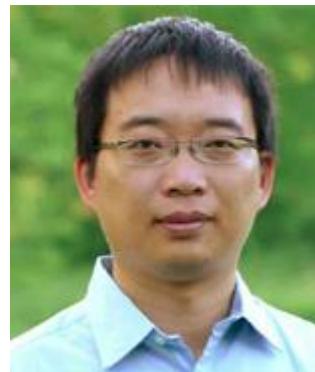
PEOPLE



WHO ARE WE?



Prof. Shaowei Lin
Instructor
Weeks 1-7



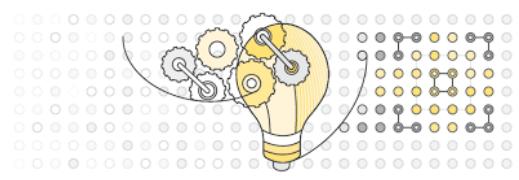
Prof. Lu Wei
Instructor
Weeks 8-14



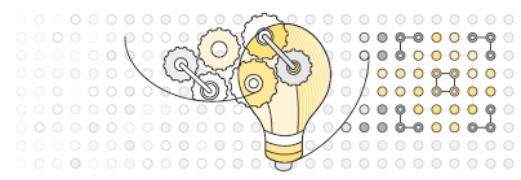
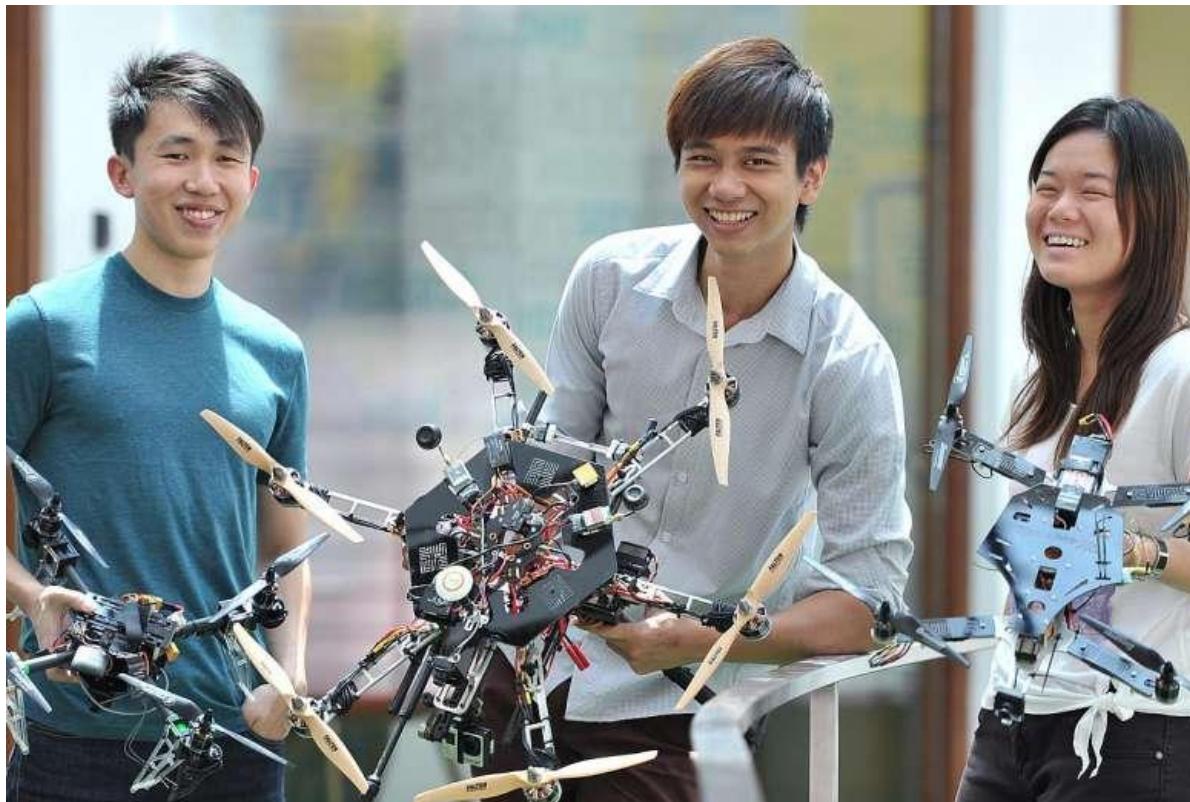
Li Hao
Teaching Assistant
Class 1

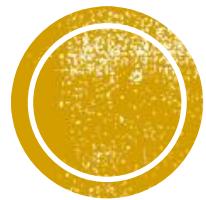


Zhang Yan
Teaching Assistant
Class 2

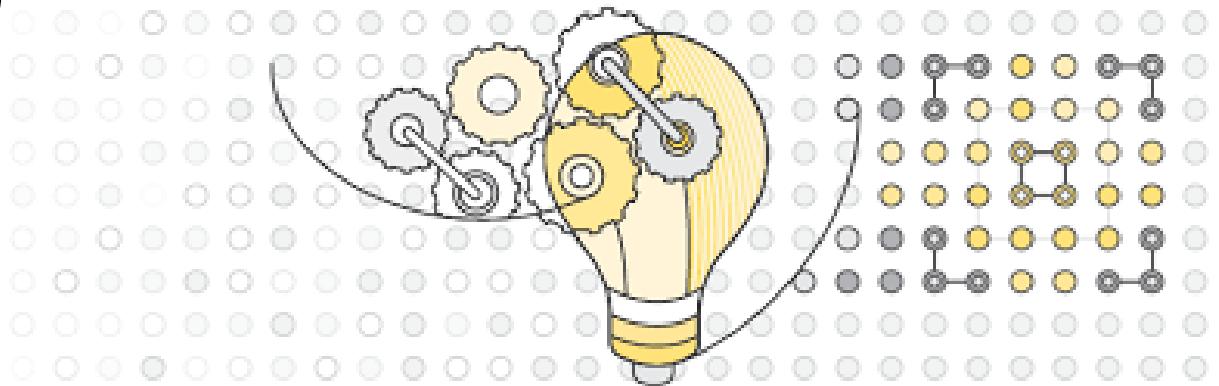


WHO ARE YOU?



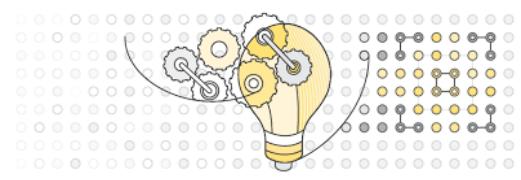


CLASS



COURSE INFORMATION

- Office Hours
- Lessons
- Prerequisites
- Assessment
- Schedule
- Textbooks
- Syllabus
- Software
- Project
- Homework
- eDimension
- Observers



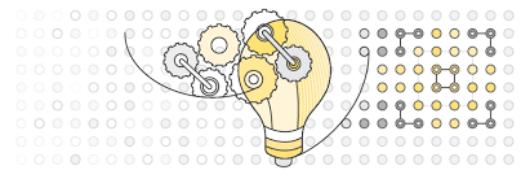
COURSE GOALS

1. Curious to discover more
2. Confident of doing it yourself
3. Contemplative of the theory
4. Cautious of the dangers



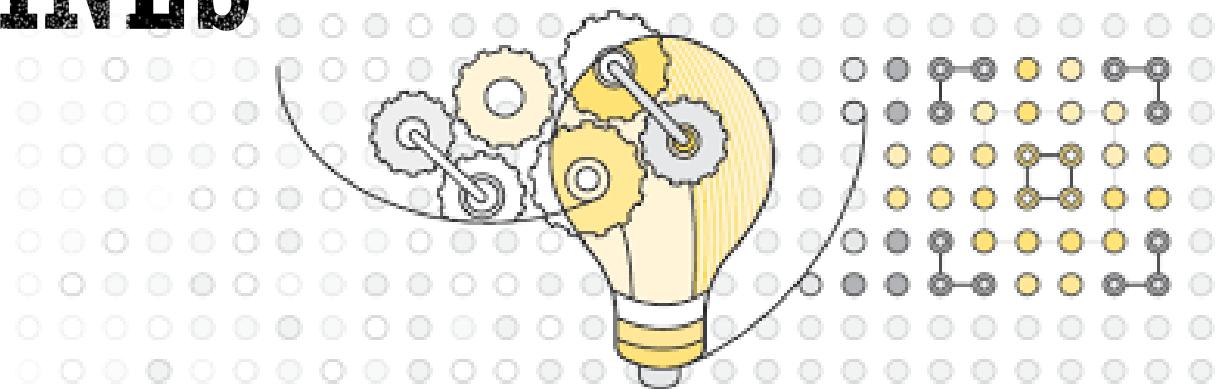
ACKNOWLEDGEMENTS

- MIT 6.036 Introduction to Machine Learning
- SUTD 50.007 Machine Learning (Alex Binder)
- Stanford CS229 Machine Learning





MACHINES



WHAT IS MACHINE LEARNING?

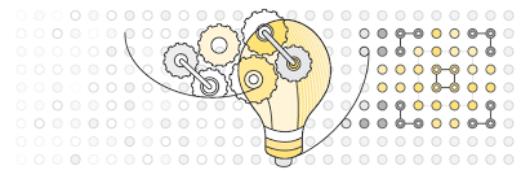


Hard-Coded



Trained

Giving computers the ability to learn
without being explicitly programmed
– Arthur Samuel (1959)



WHAT IS MACHINE LEARNING?



Task



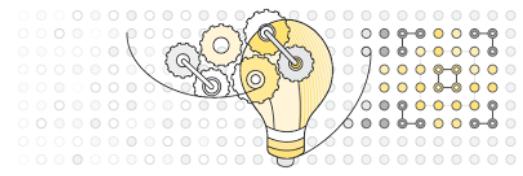
Performance



Experience

Algorithms that improve their performance
at some task with experience

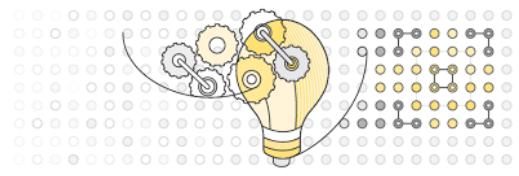
– Tom Mitchell (1998)



TYPES OF MACHINE LEARNING



Supervised Learning



TYPES OF MACHINE LEARNING



Unsupervised Learning

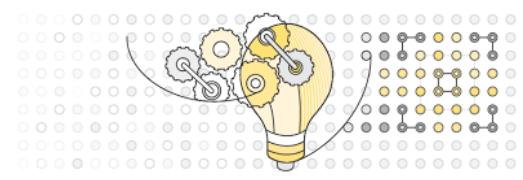


TYPES OF MACHINE LEARNING



Playing is more
fun than watching!

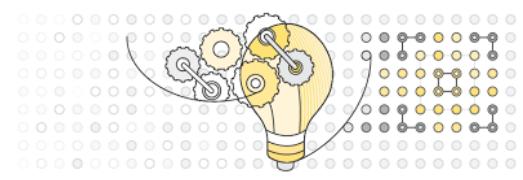
Reinforcement Learning



TYPES OF MACHINE LEARNING

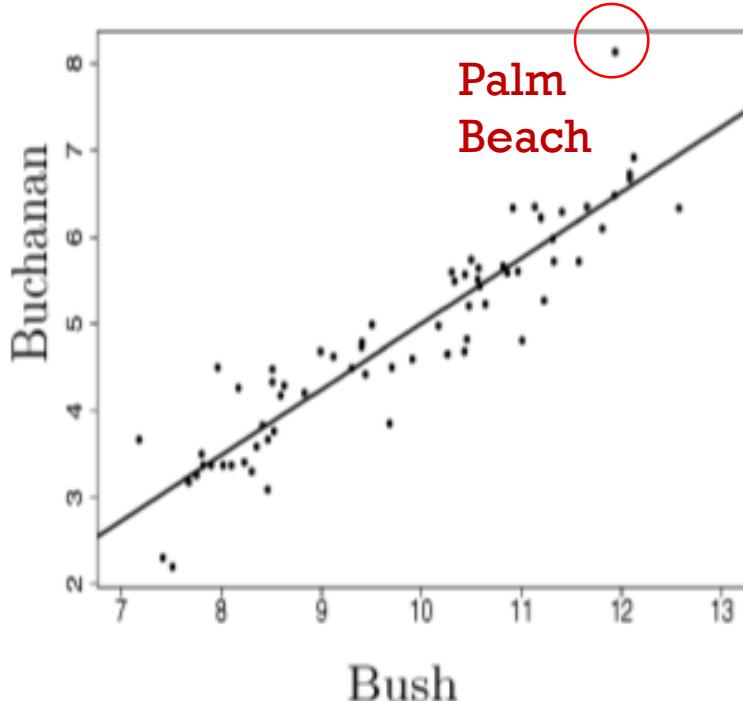


Transfer Learning



SUPERVISED LEARNING

Regression (Linear)



Learning a function

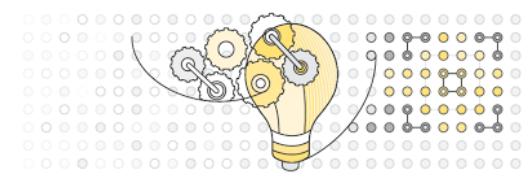
$$y = f(x)$$

$$x \in \mathbb{R}$$

$$y \in \mathbb{R}$$

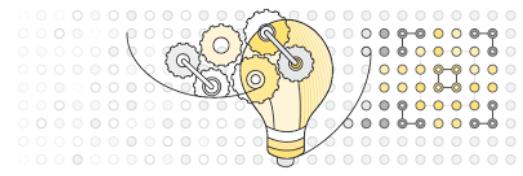
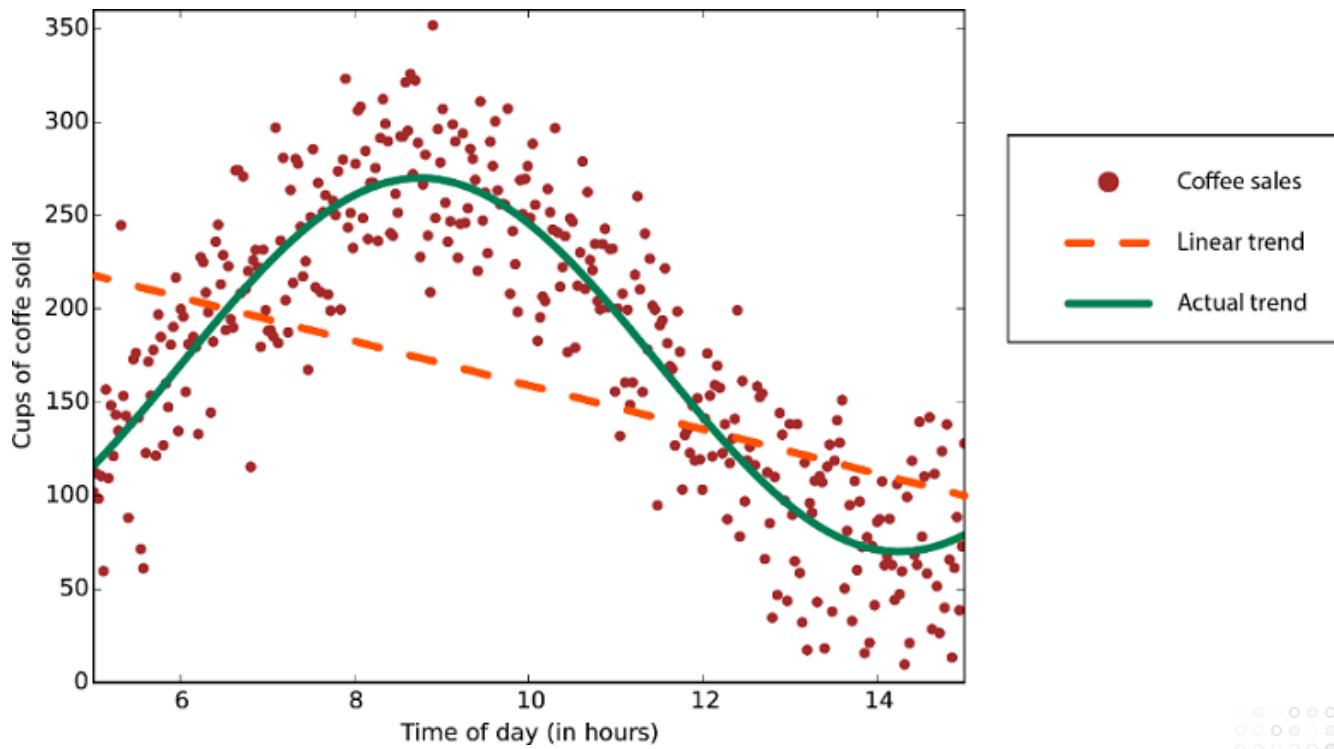
2000 USA Presidential Elections.

Votes for Buchanan and Bush in cities of Florida on a log scale.



SUPERVISED LEARNING

Regression (Non-linear)



SUPERVISED LEARNING

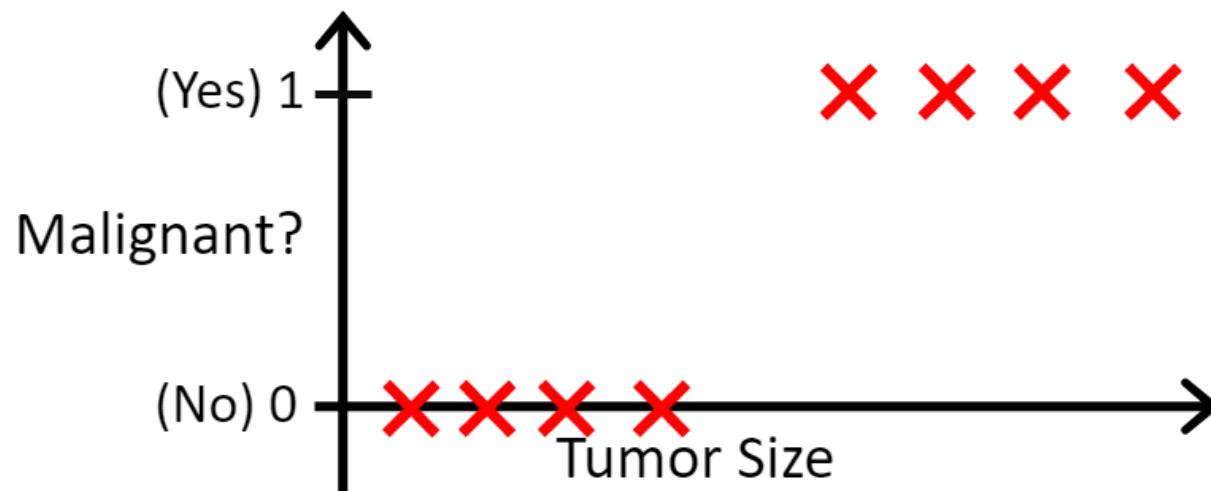
Classification

Learning a function

$$y = f(x)$$

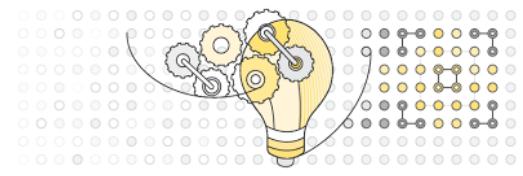
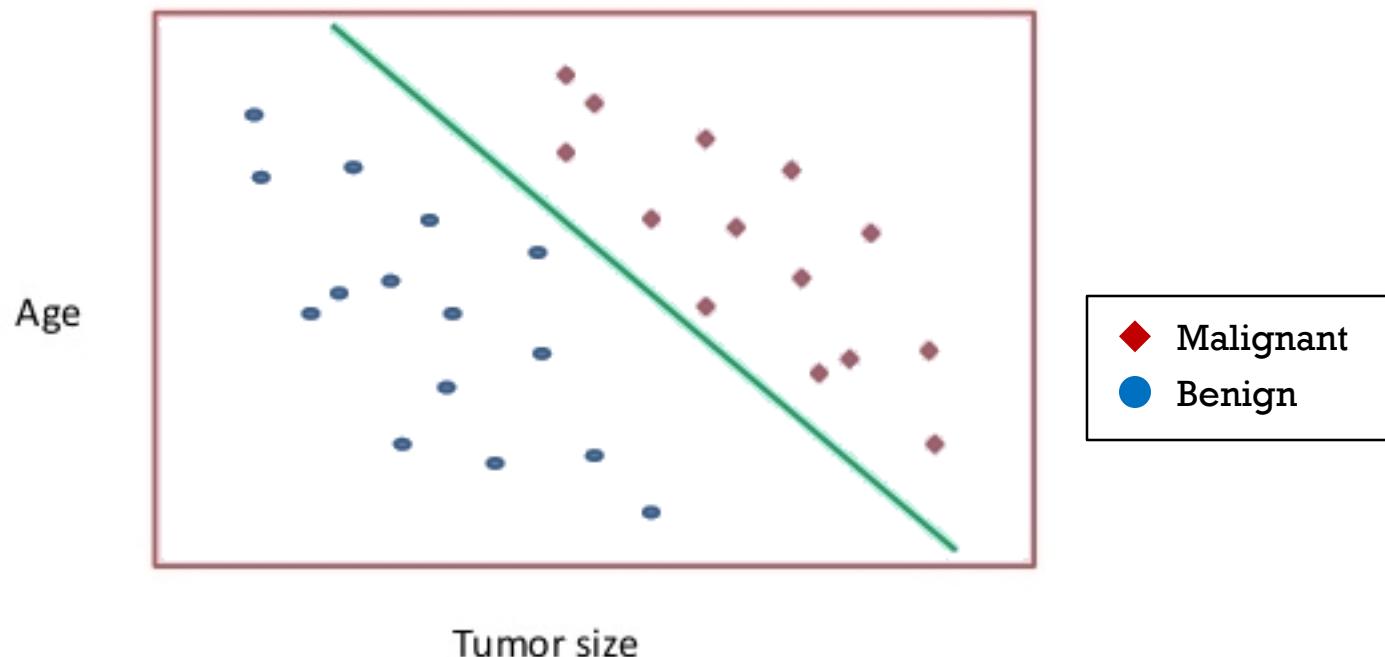
$$x \in \mathbb{R}$$

$$y \in \{1, 2, \dots, k\}$$



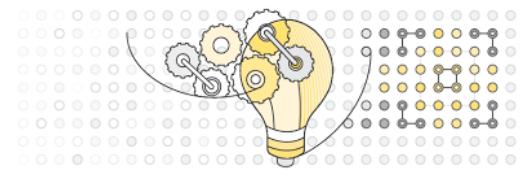
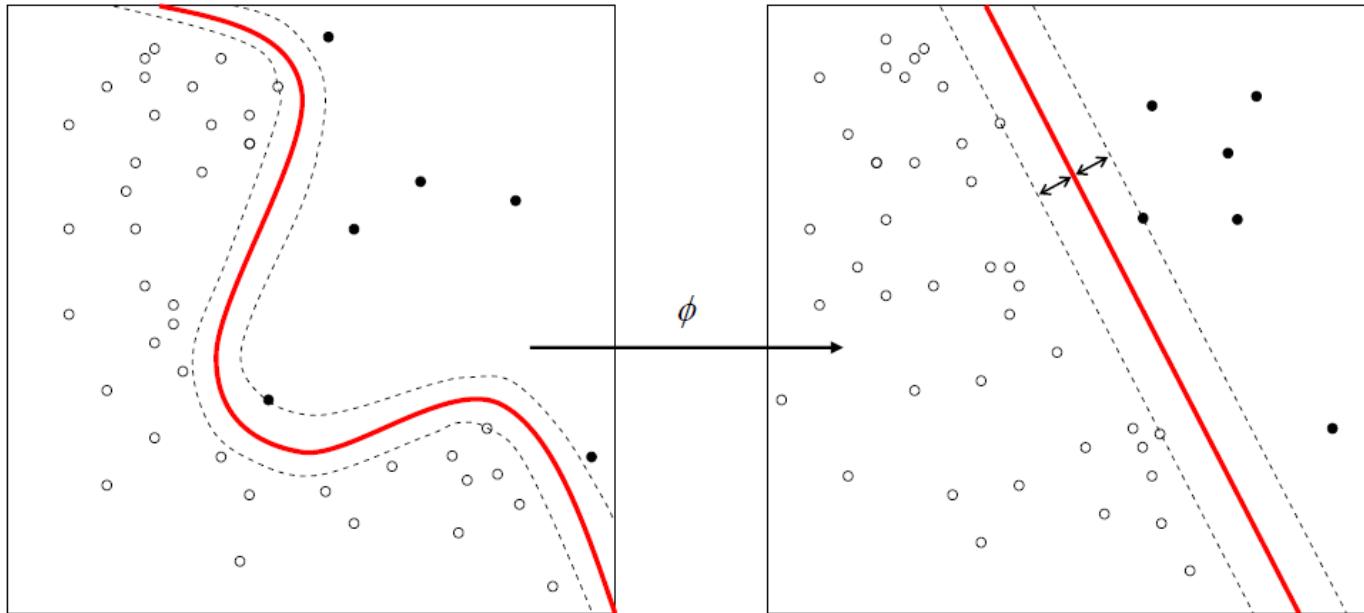
SUPERVISED LEARNING

Classification (Linear)



SUPERVISED LEARNING

Classification (Non-linear)

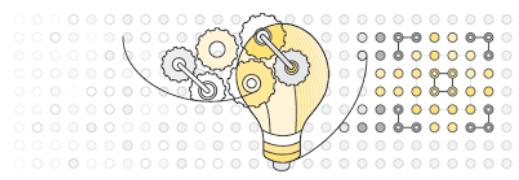


SPAM FILTERS

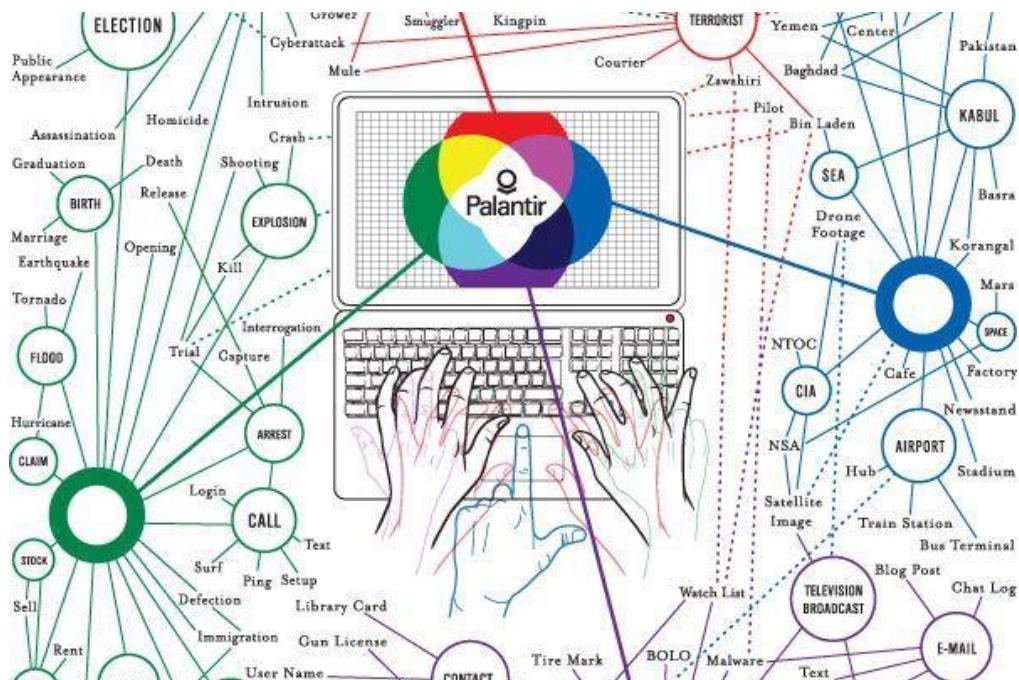
Spam-Filter



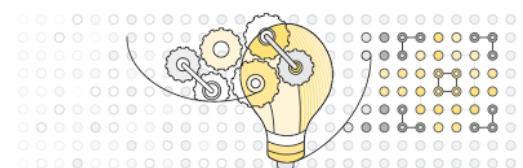
Bayesian
Networks



FRAUD DETECTION



P PayPal
eBay

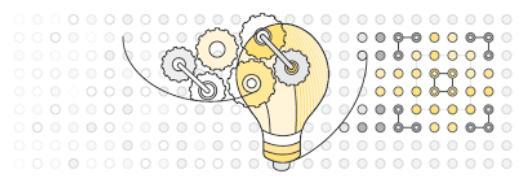
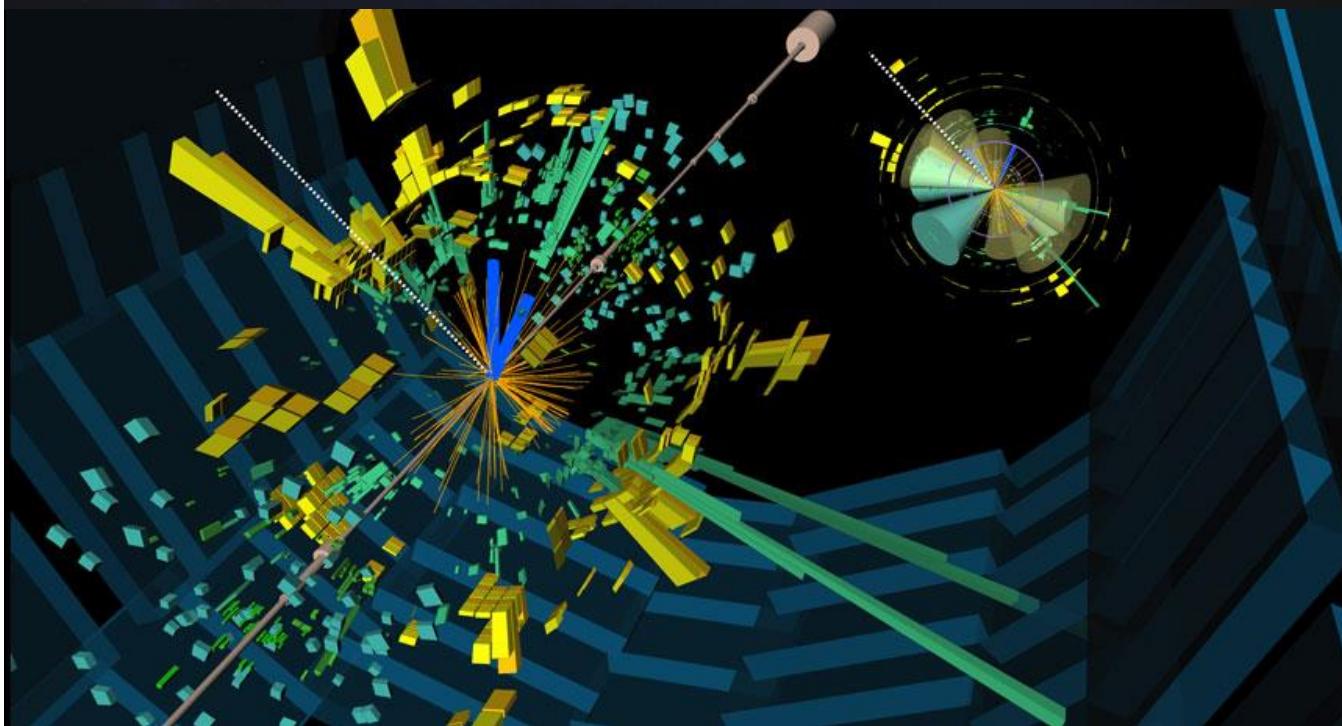


Higgs
challenge

the HiggsML challenge

May to September 2014

When **High Energy Physics** meets **Machine Learning**

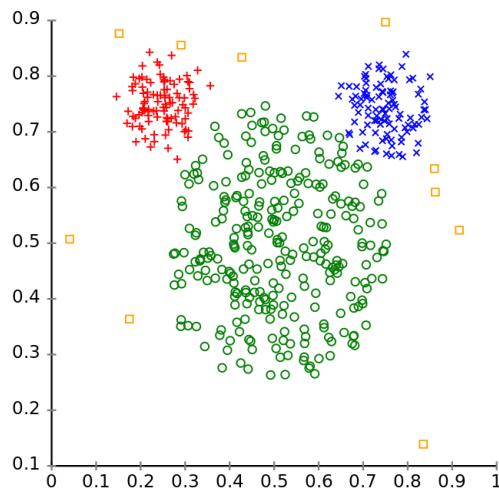


UNSUPERVISED LEARNING

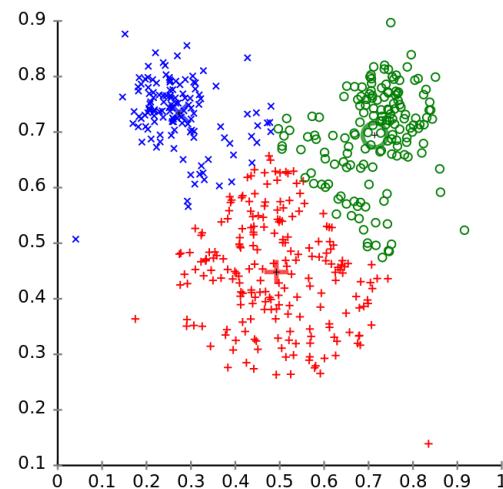
Clustering

Different cluster analysis results on "mouse" data set:

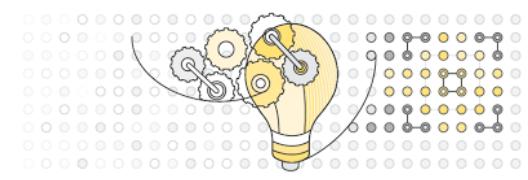
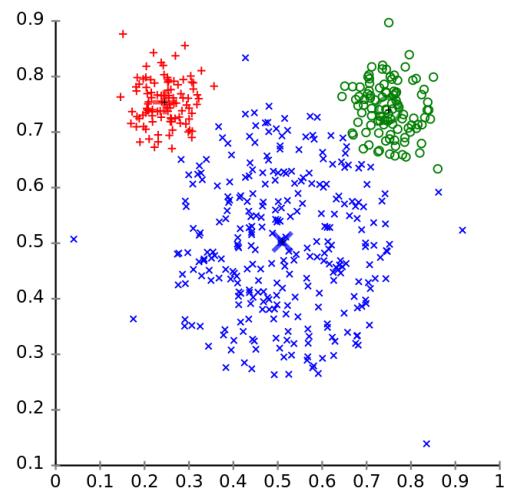
Original Data



k-Means Clustering

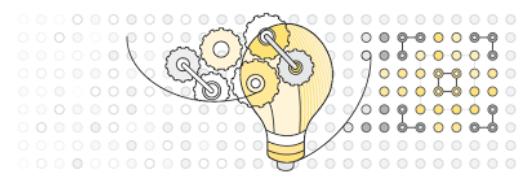
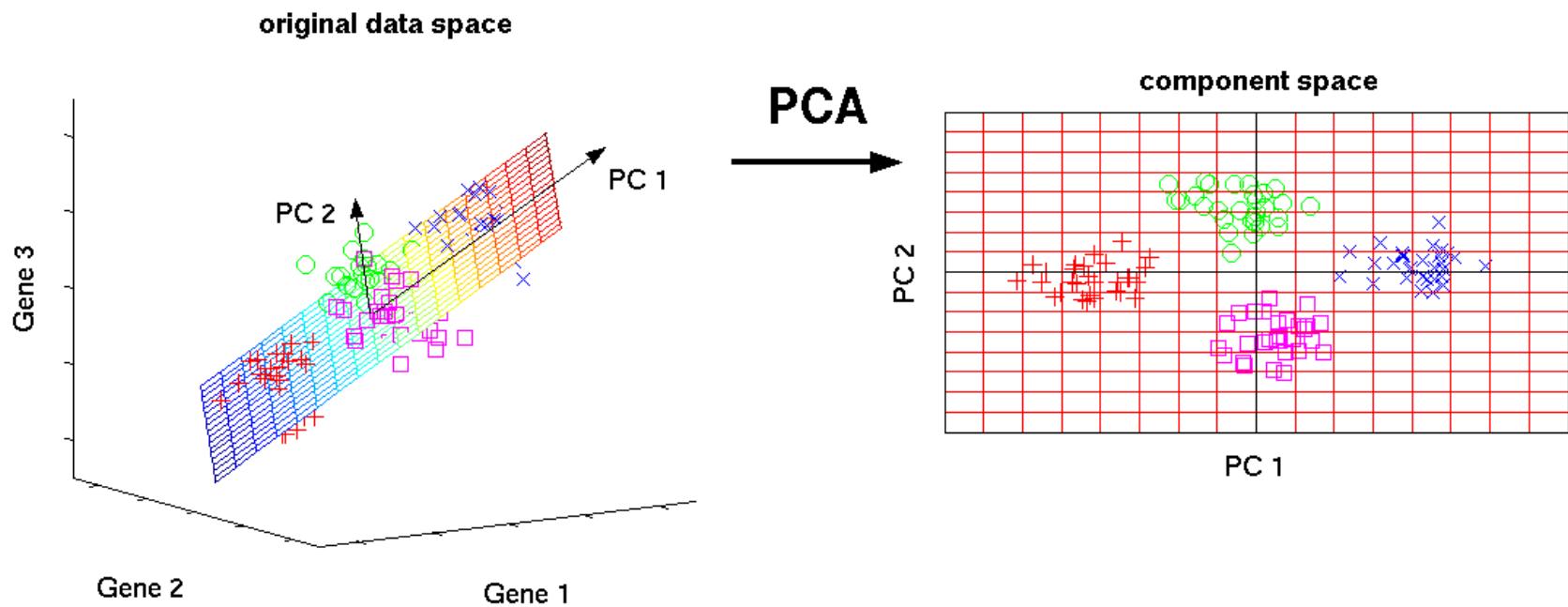


EM Clustering



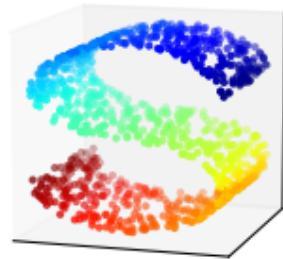
UNSUPERVISED LEARNING

Dimensionality Reduction

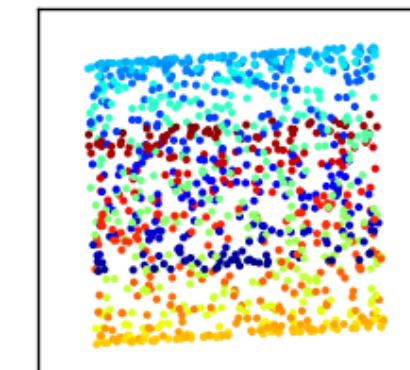


UNSUPERVISED LEARNING

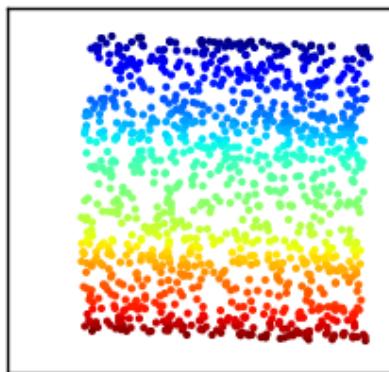
Manifold Learning



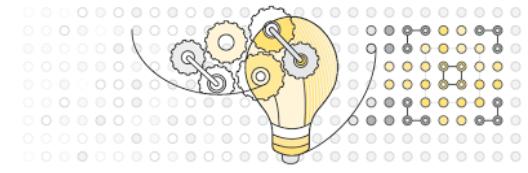
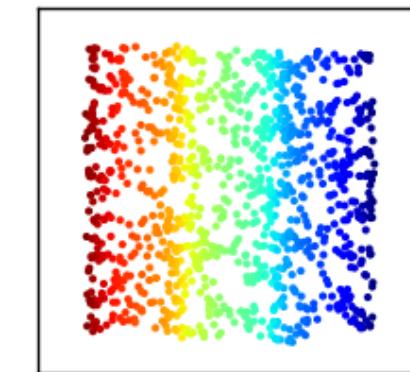
PCA projection



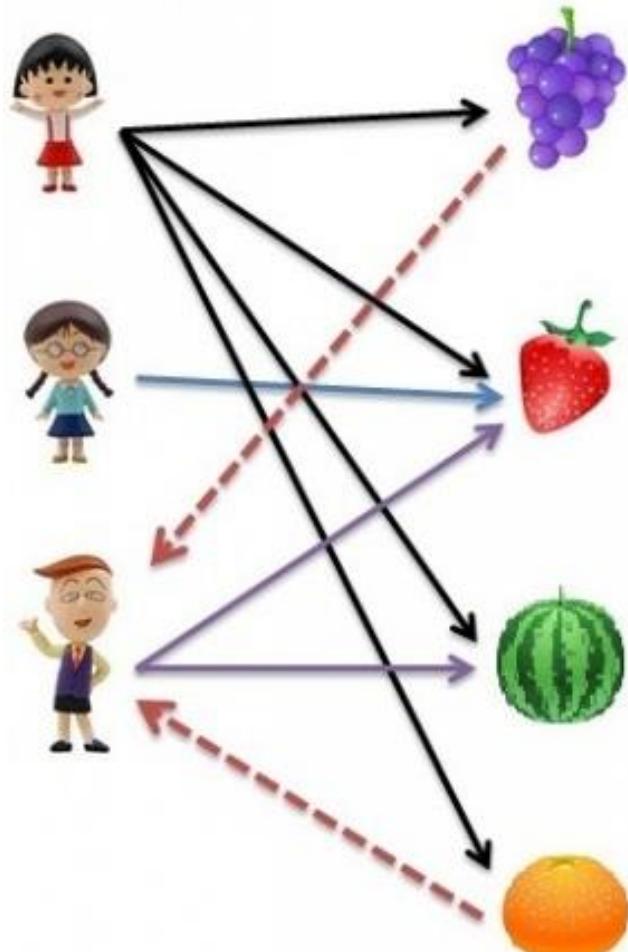
LLE projection



IsoMap projection

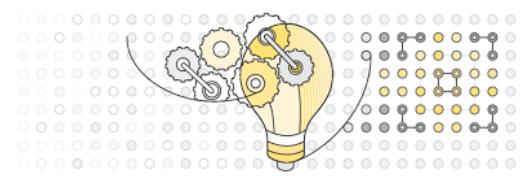


RECOMMENDER SYSTEMS

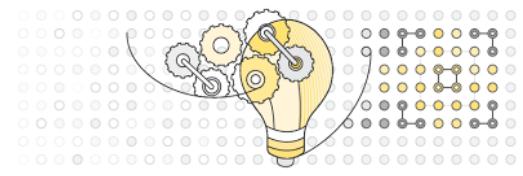
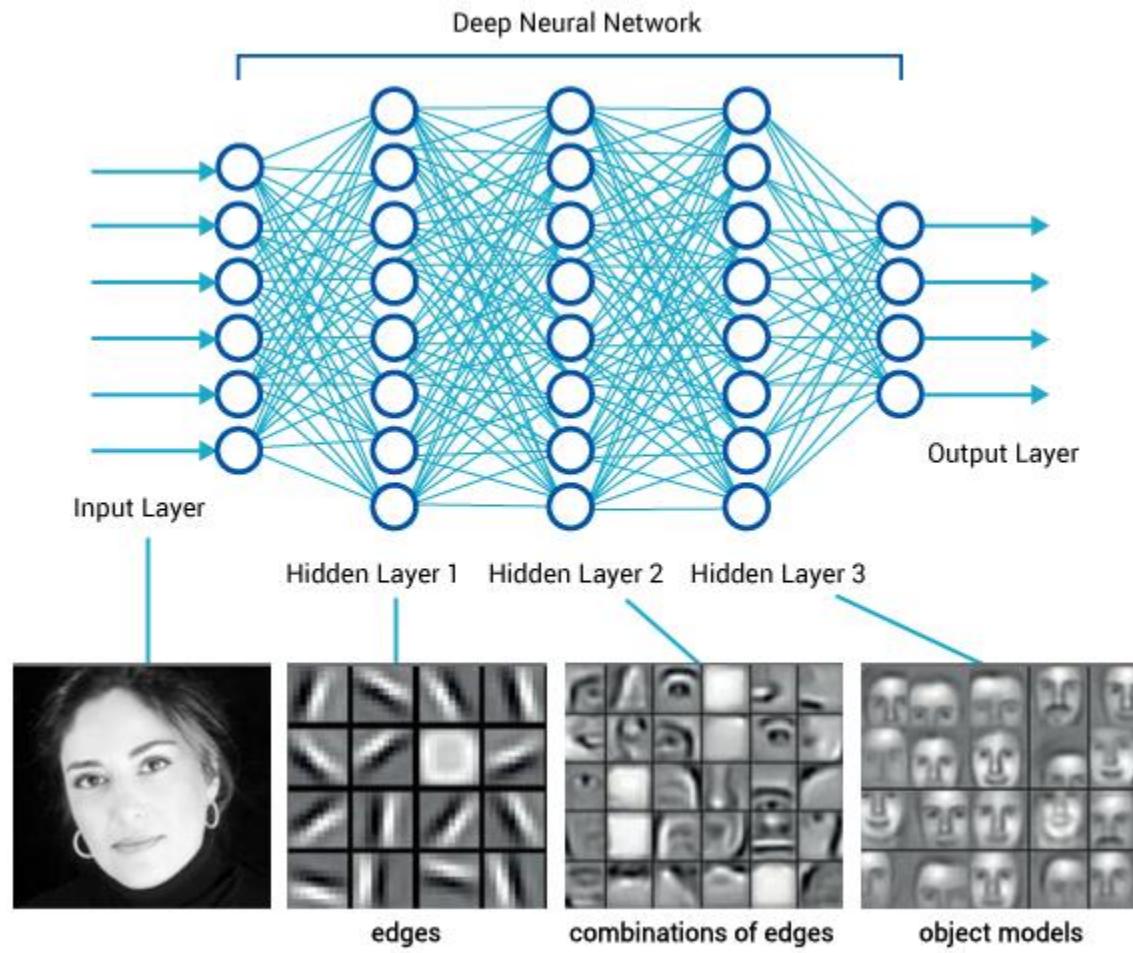


Low-Rank Matrix Factorization

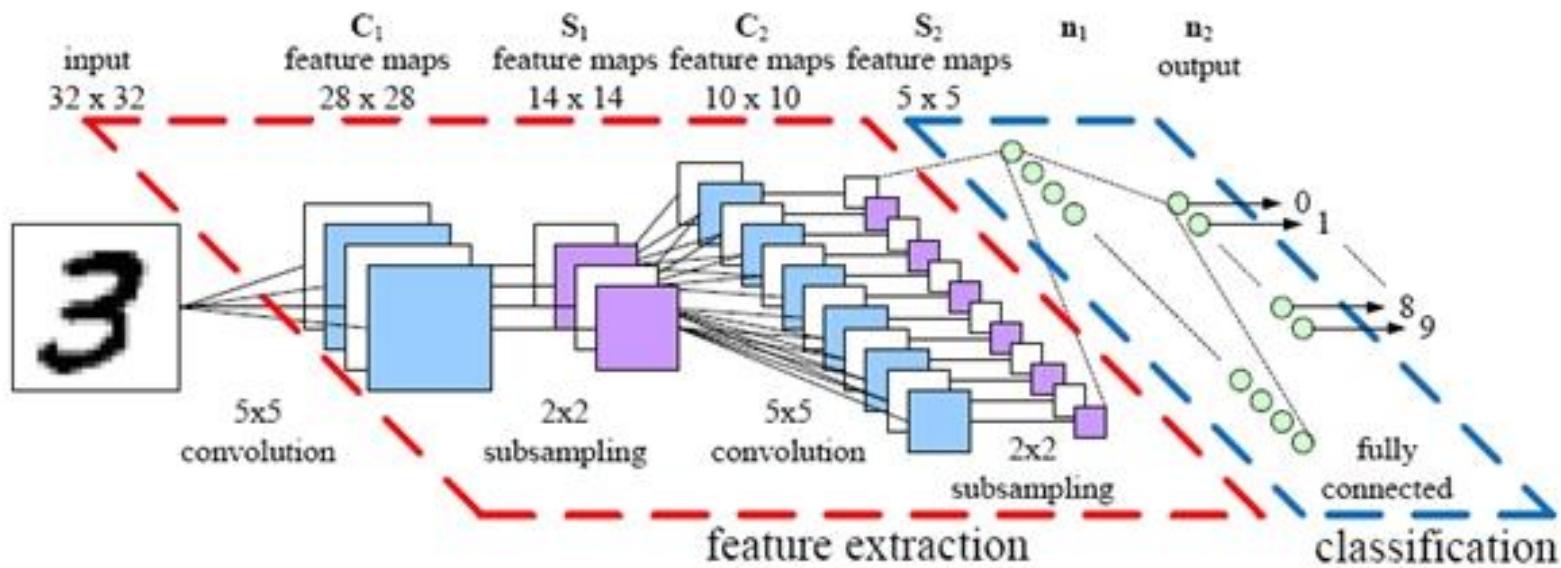
$$\text{Ratings} \approx \begin{matrix} \text{Users} \\ \times \\ \text{Movies} \end{matrix} \begin{matrix} f(i) \\ f(j) \end{matrix}$$



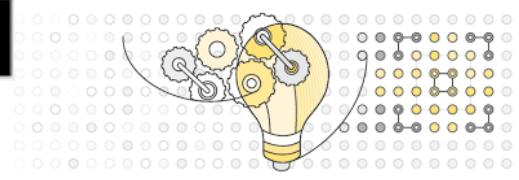
DEEP LEARNING



HANDWRITING RECOGNITION



0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9



GOOGLE CAT VIDEOS

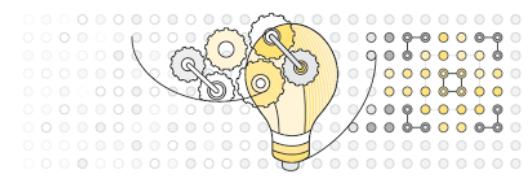
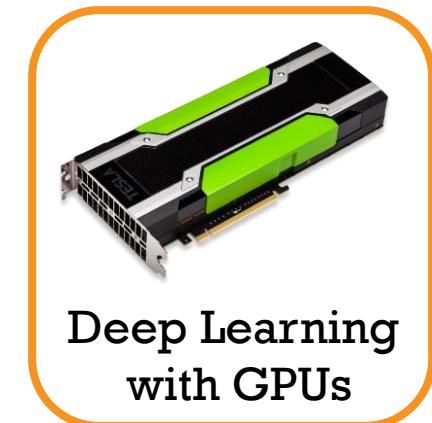
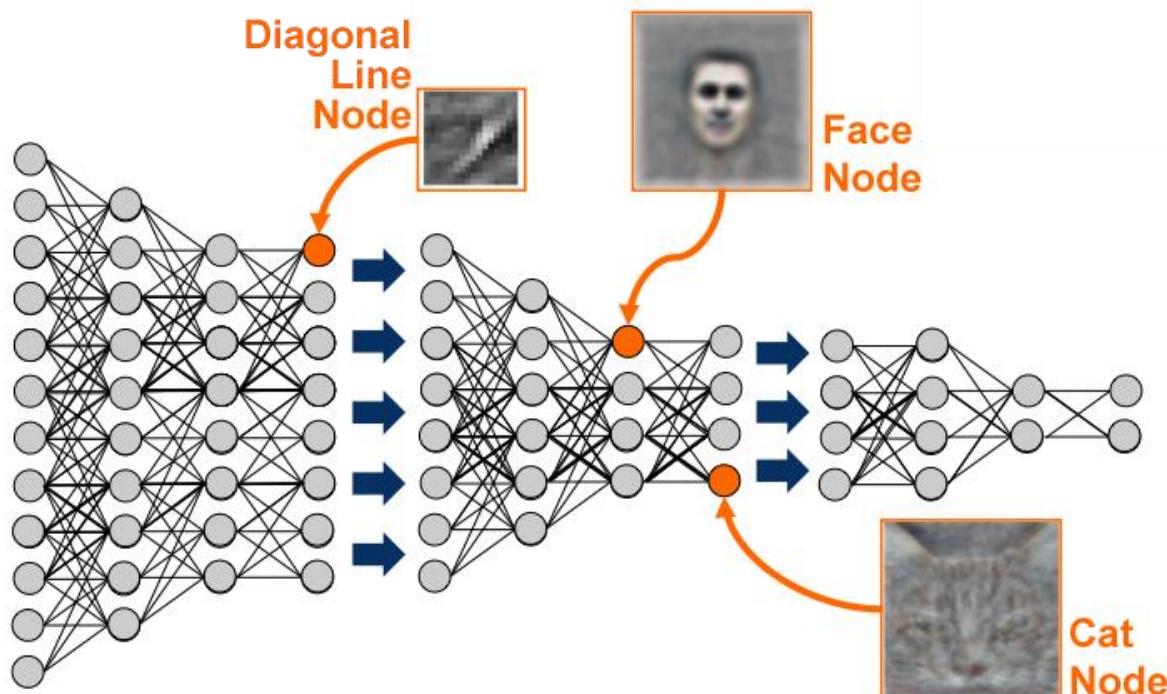
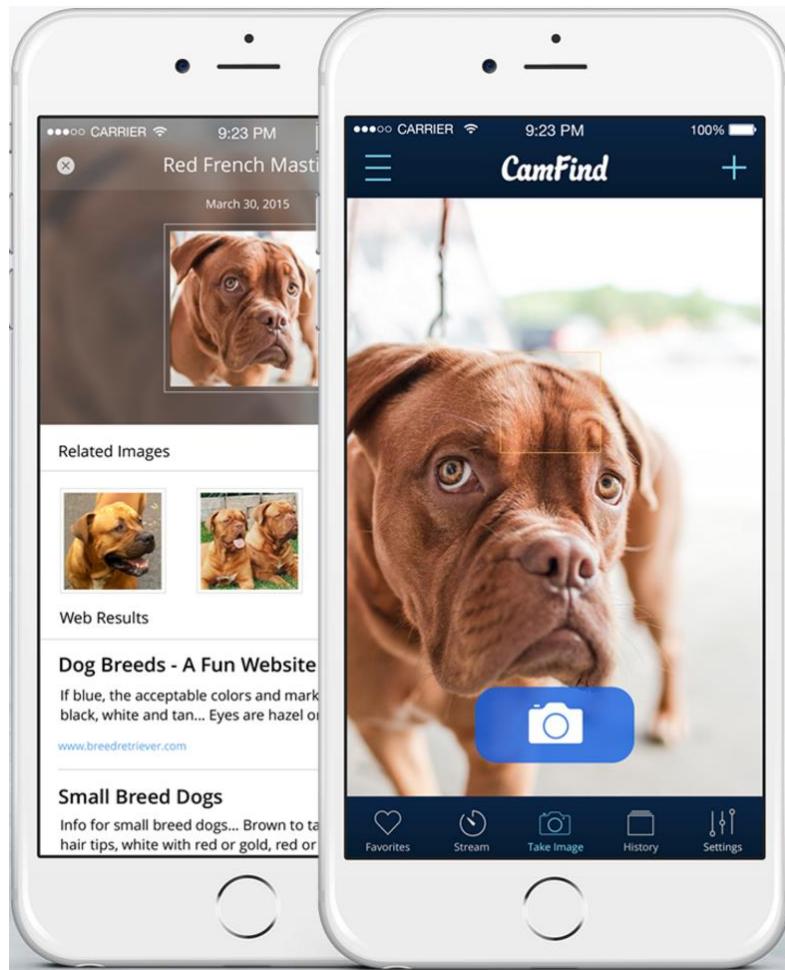
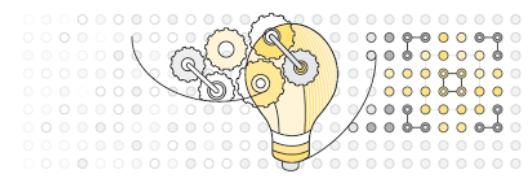


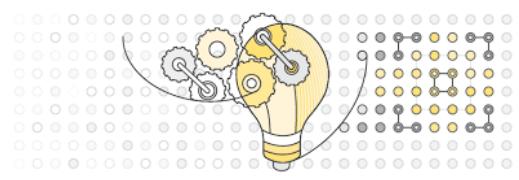
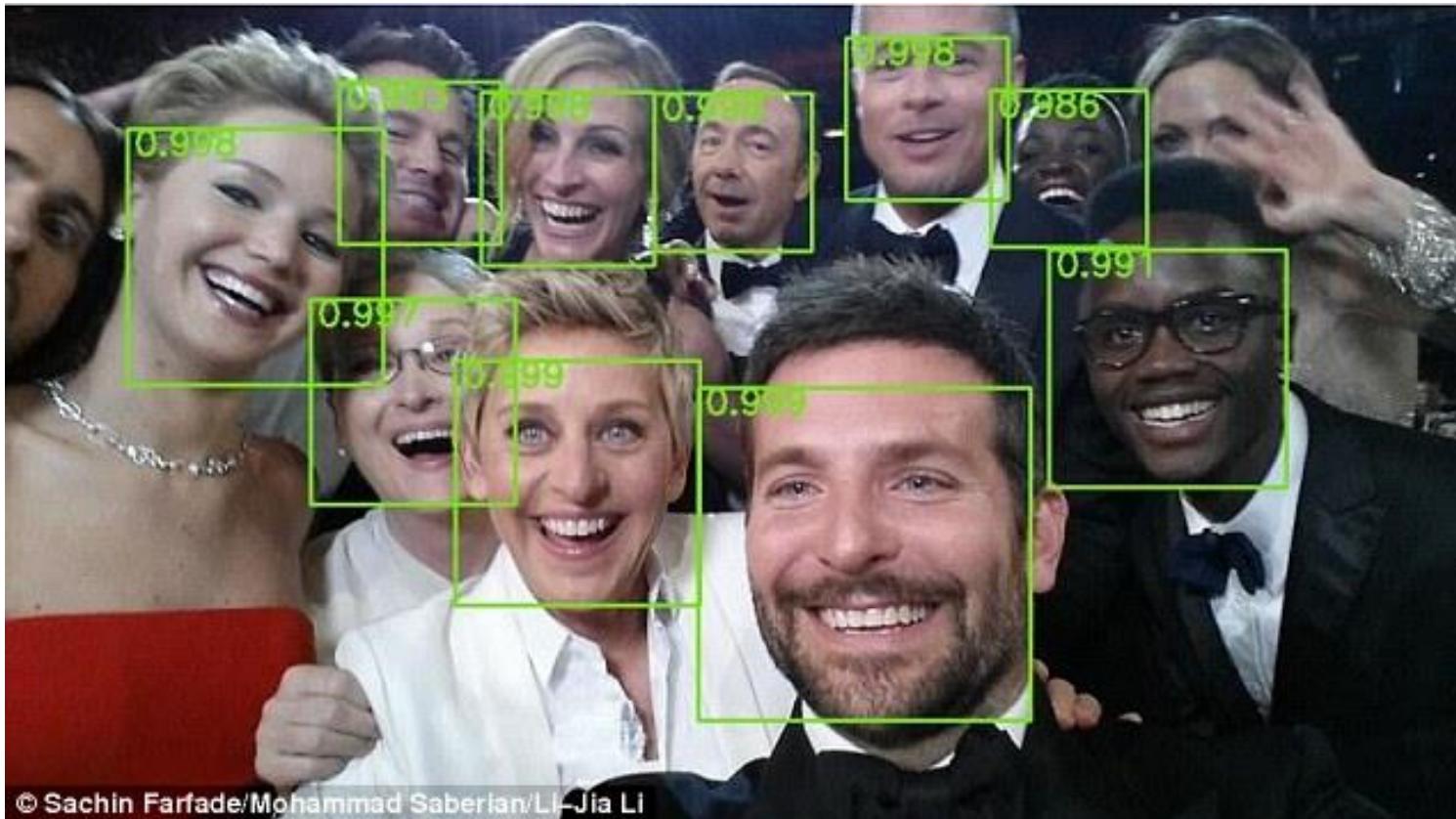
IMAGE RECOGNITION



CamFind
Visual Search Engine
(available on iOS, Android)



FACE RECOGNITION



SPEECH TRANSLATION



Hi grandma. Happy birthday. Are you having a great day?

Hola abuela. Feliz cumpleaños. ¿Tienes un buen día?

Hi Dylan. Yes, a great day thanks. And the flowers that you have sent are precious.

Hola Dylan. Sí, un día estupendo gracias. Y las flores que has enviado son preciosas.

I'm glad they arrived.

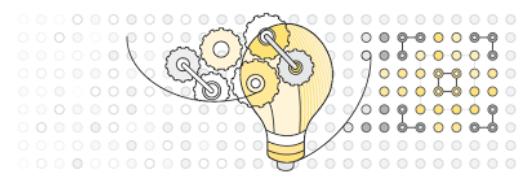
Me alegra que llegaron.

They arrived first thing in the morning.

Llegaron a primera hora de la mañana.

Type a message here

From Hidden Markov Models to Recurrent Neural Networks



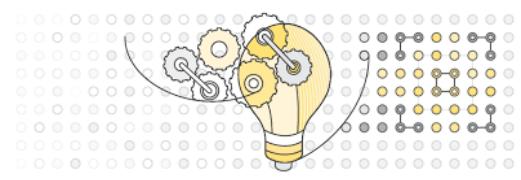
HEALTHCARE

Watson correctly diagnoses woman after doctors were stumped

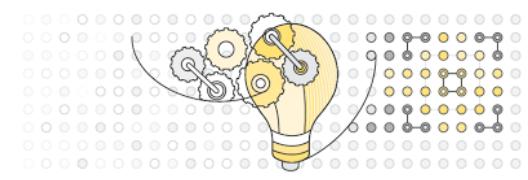
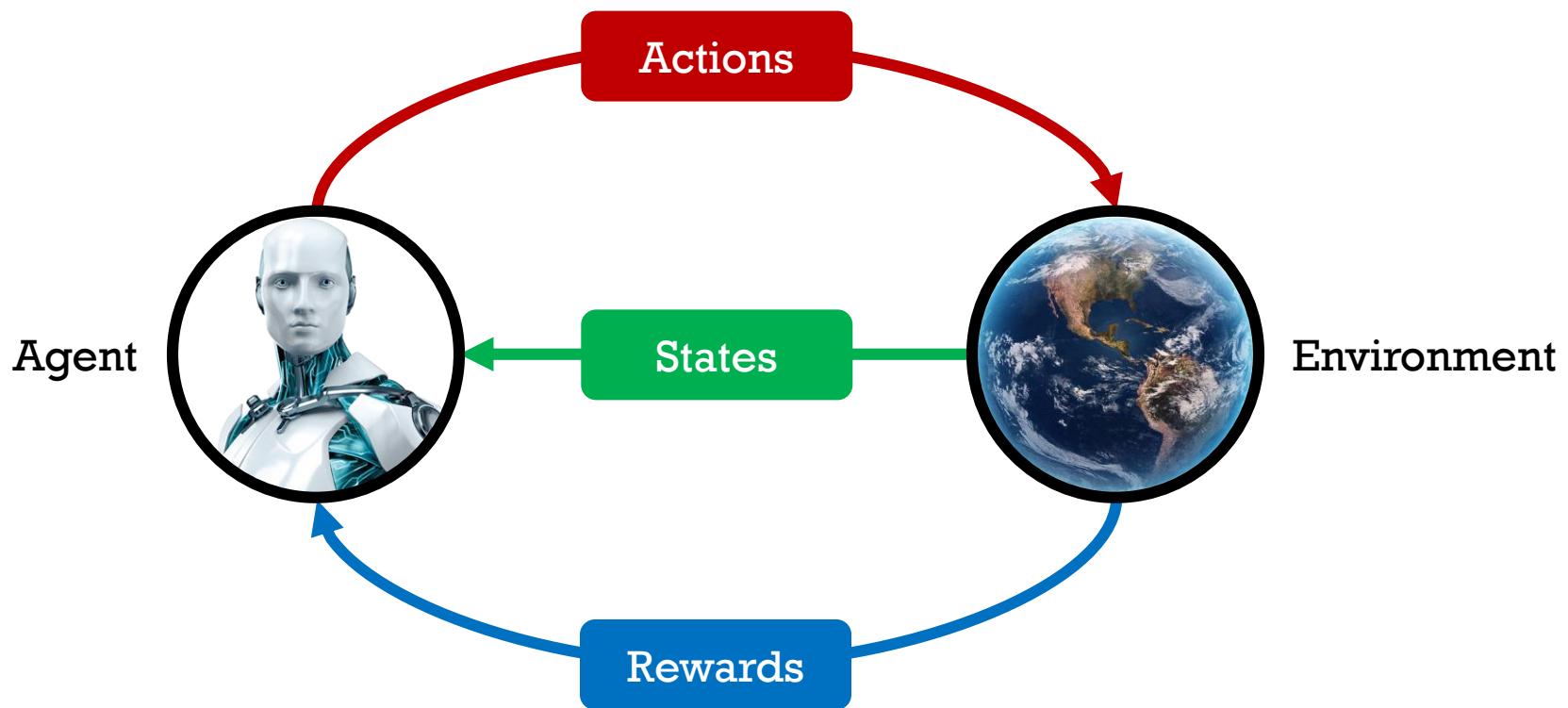
by Eric David | Aug 5, 2016 | 0 comments



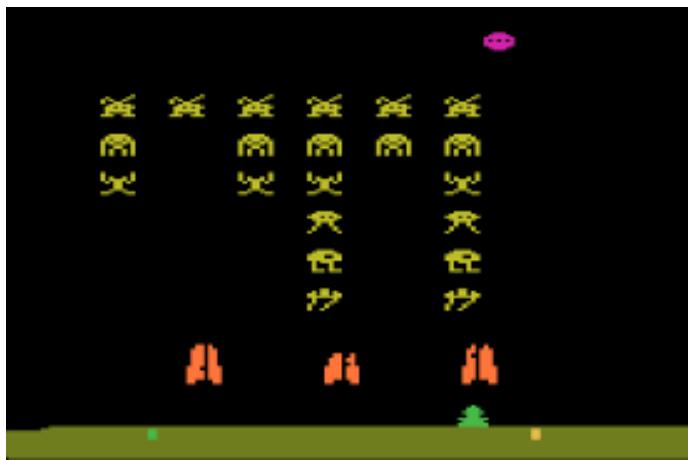
After treatment for a woman suffering from leukemia proved ineffective, a team of Japanese doctors turned to IBM's Watson for help, which was able to successfully determine that she actually suffered from a different, rare form of leukemia than the doctors had originally believed.



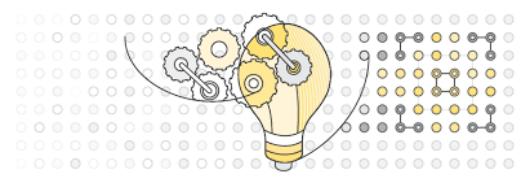
REINFORCEMENT LEARNING



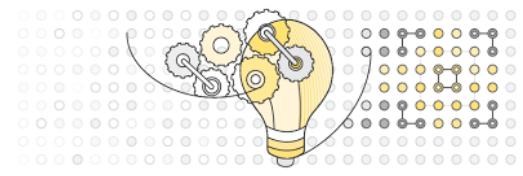
ATARI GAMES



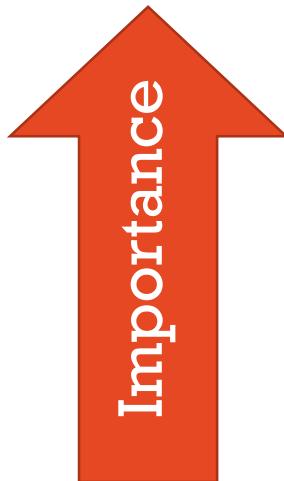
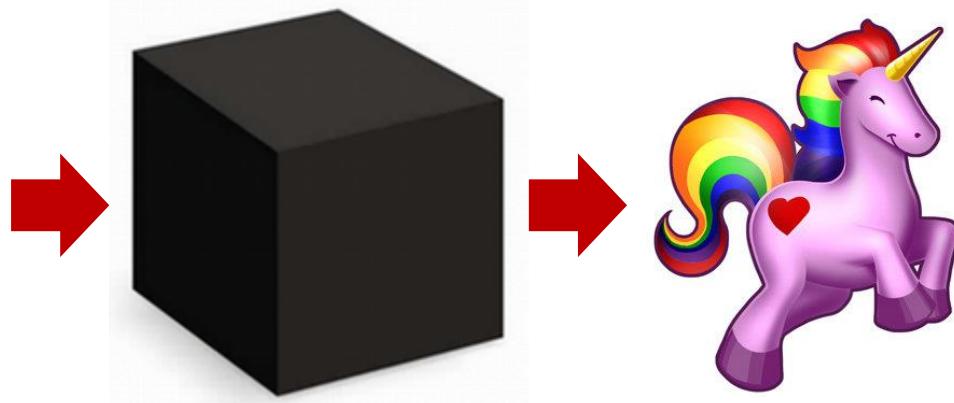
Google DEEPMIND



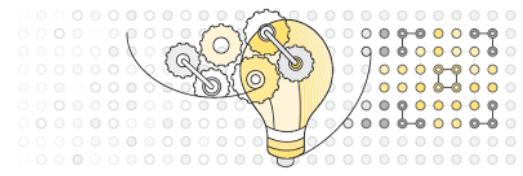
SELF-DRIVING CARS



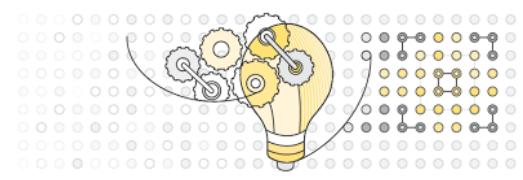
NOT A BLACK BOX!



More Structure
More Data
Better Machines
Better Algorithms



DETECTING TANKS



http://lesswrong.com/lw/7qz/machine_learning_and_unintended_consequences/

<https://www.jefftk.com/p/detecting-tanks>

ALPHAGO

