

Introduction to Machine Learning

About CloudxLab

Making learning fun and for life



Videos



Quizzes



Hands-On



Projects



Case Studies

Real Life Use Cases



Automated Hands-on Assessments



Learn by doing



Automated Hands-on Assessments



Problem Statement



Hands On



Assessment

Automated Hands-on Assessments

Last Attempt Result: 3 / 87 Last Attempt: 1 week, 2 days ago

Getting Started With Linux Console

Please follow these steps:

1. Log into your CloudxLab Account: [Open CloudxLab](#)
2. Select the "**Credentials**" tab. You should see your login and passwords. You can copy the login and password using the icons.
3. Click on "**Web Console**" (Alternatively you could use SSH or [Putty](#))
4. Enter your login and password. You can copy-paste from "[My Lab](#)"
5. If you are successfully logged in, please click on "I am Done! Please Check" button below.

Session 4 - web console - CloudxLab hands-on demo

Linux Shell

What is it?

>-

0:00 / 2:24

Best way of interacting with Hadoop components

- Read-Evaluate-print Loop
- Open interactive consoles such as Python, R, Spark, Hive, Pig
- Great for automation

Shell Programs:

- Web Console (Browser)
- Putty (Windows)
- ssh from Linux or Mac
- [Many Terminal Apps in Android](#)

I am Done! Please Check

Evaluation

Edit Jump to page Previous Next

Problem Statement



Automated Hands-on Assessments

 CLOUD X LAB

KnowBigData - Hadoop-Spark With Python (Live Recordings)

Last Attempt Result:  19 / 19

Last Attempt: a minute ago

Testing Python

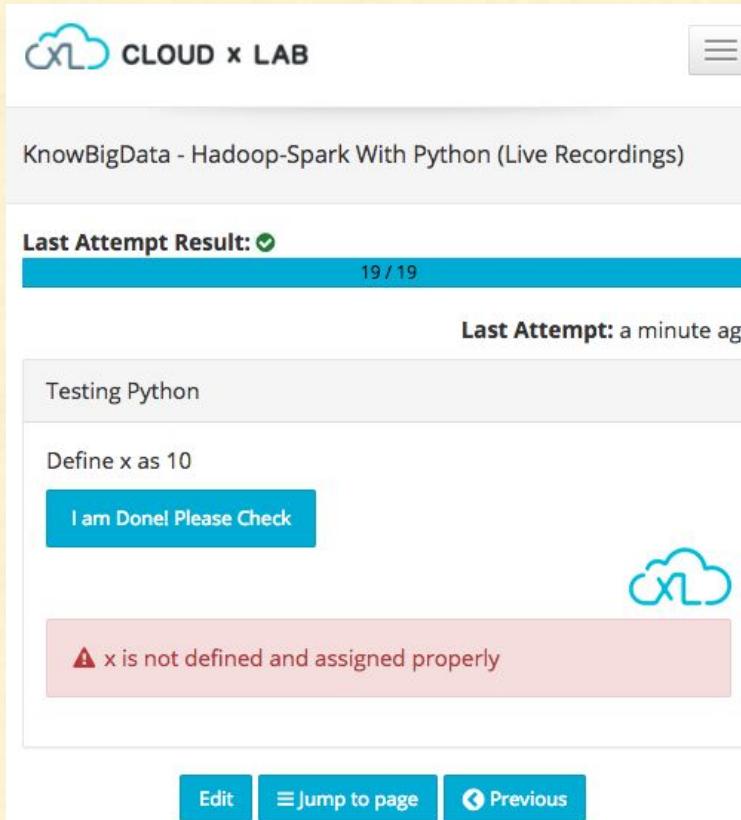
Define x as 10

I am Done! Please Check



⚠ x is not defined and assigned properly

Edit Jump to page Previous



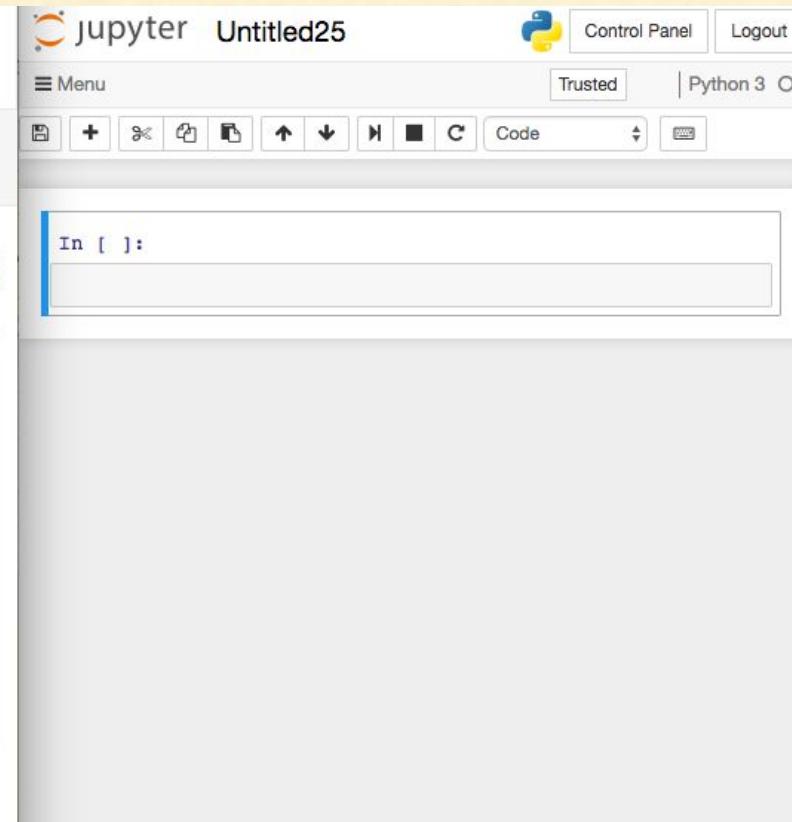
[Python Assessment](#)

jupyter Untitled25

Control Panel Logout

Menu Trusted Python 3

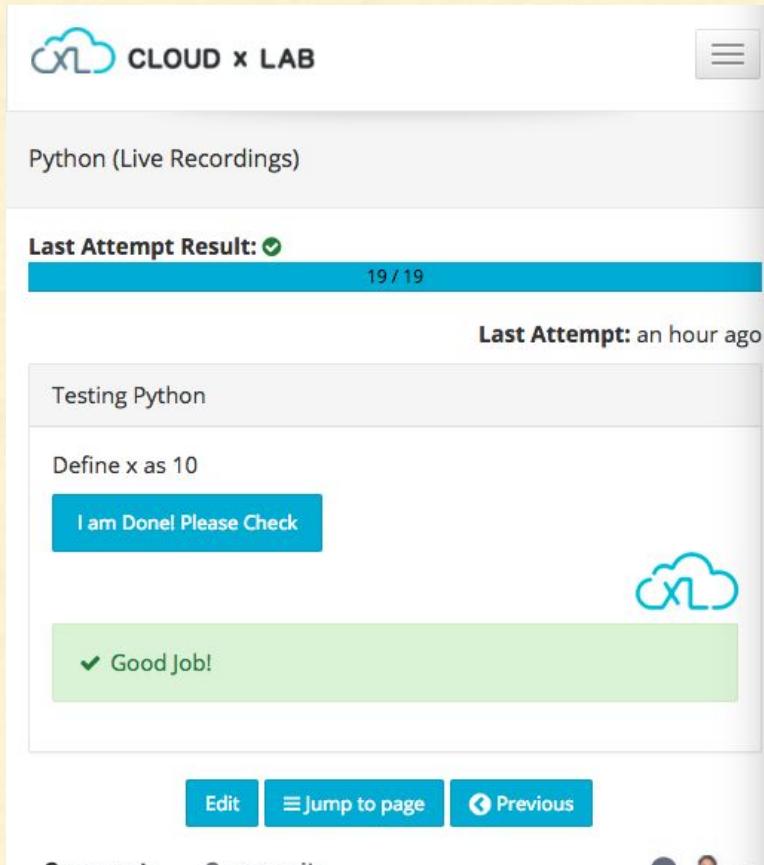
In []:



[Jupyter Notebook](#)

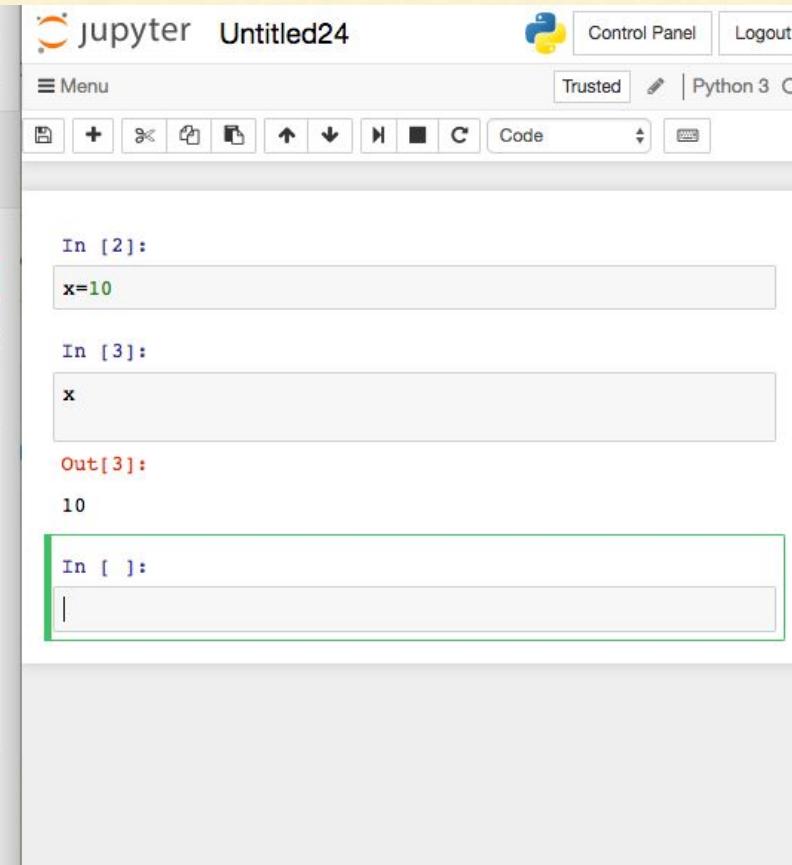


Automated Hands-on Assessments



The screenshot shows the Cloud X LAB Python Assessment interface. At the top left is the Cloud X LAB logo. Below it, the title "Python (Live Recordings)" is displayed. A progress bar indicates "Last Attempt Result: 19 / 19". The message "Last Attempt: an hour ago" is shown below the progress bar. A section titled "Testing Python" contains the instruction "Define x as 10" and a button labeled "I am Done! Please Check". A green success message "Good Job!" is displayed at the bottom. Navigation buttons at the bottom include "Edit", "Jump to page", and "Previous".

[Python Assessment](#)



The screenshot shows a Jupyter Notebook interface titled "jupyter Untitled24". The top navigation bar includes "Control Panel" and "Logout" buttons. The notebook interface shows code cells and their outputs. Cell In [2] contains the input "x=10" and output "Out[2]: x". Cell In [3] contains the input "x" and output "Out[3]: 10". A new cell In [] is currently being edited.

[Jupyter Notebook](#)



Course Objective



**Machine Learning
with
Python - Scikit Learn**



Course Instructor



Sandeep Giri

Founder



CLOUD x LAB

Loves Explaining Technologies

Software Engineer

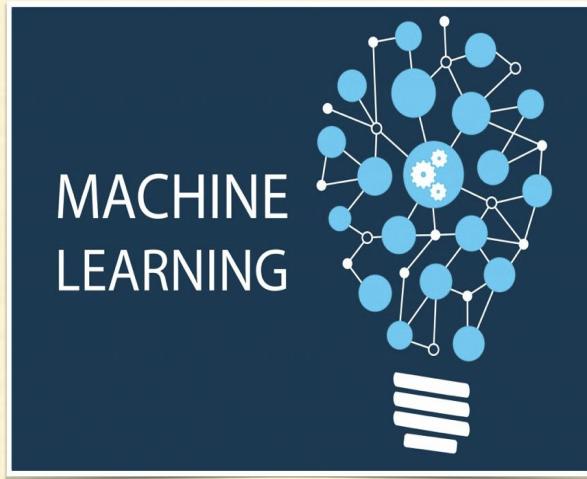


Worked On Large Scale Computing

Graduated from IIT Roorkee



What Is Machine Learning?



Field of study that gives "computers the ability to learn without being explicitly programmed"

-- Arthur Samuel, 1959

What Is Machine Learning?

Let us understand it with real use case...

Have You Played Mario?



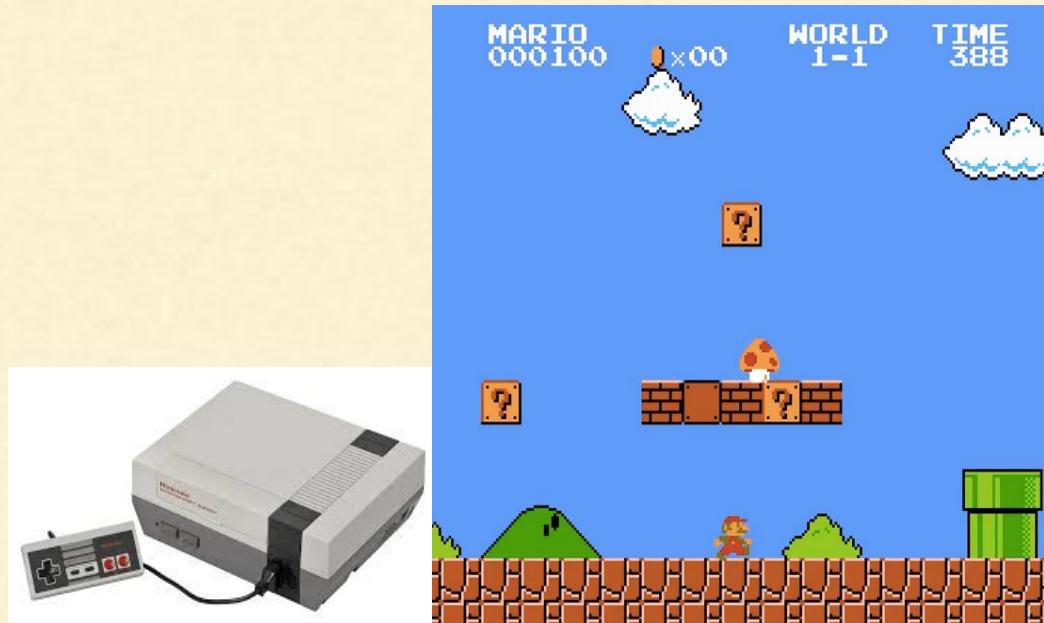
How much time did it take you to learn & win the princess?

Have You Played Mario?



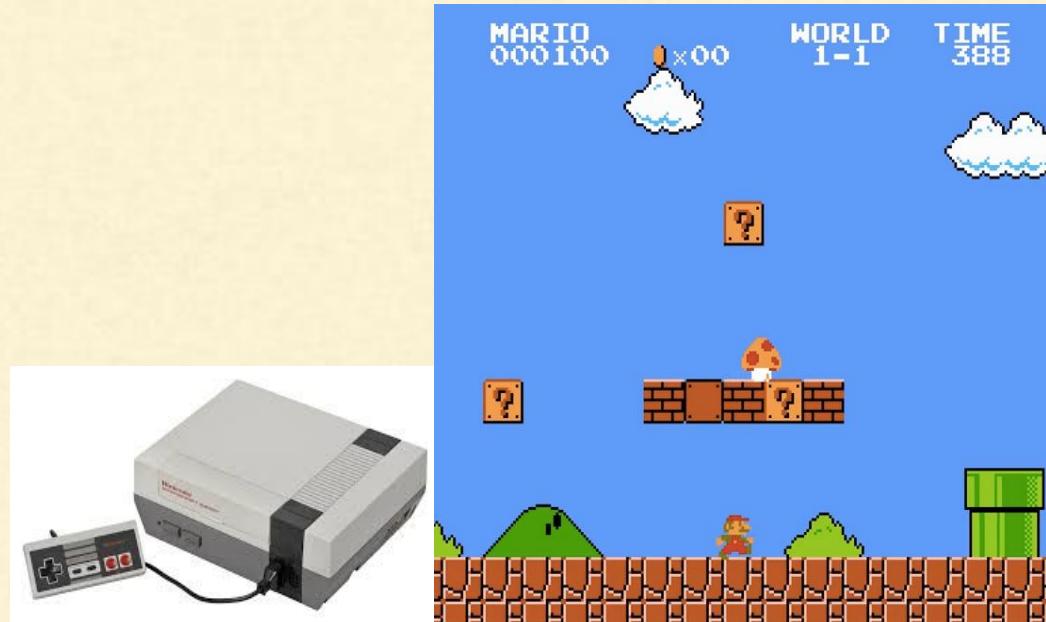
Did Anyone teach you?

How About Automating it?



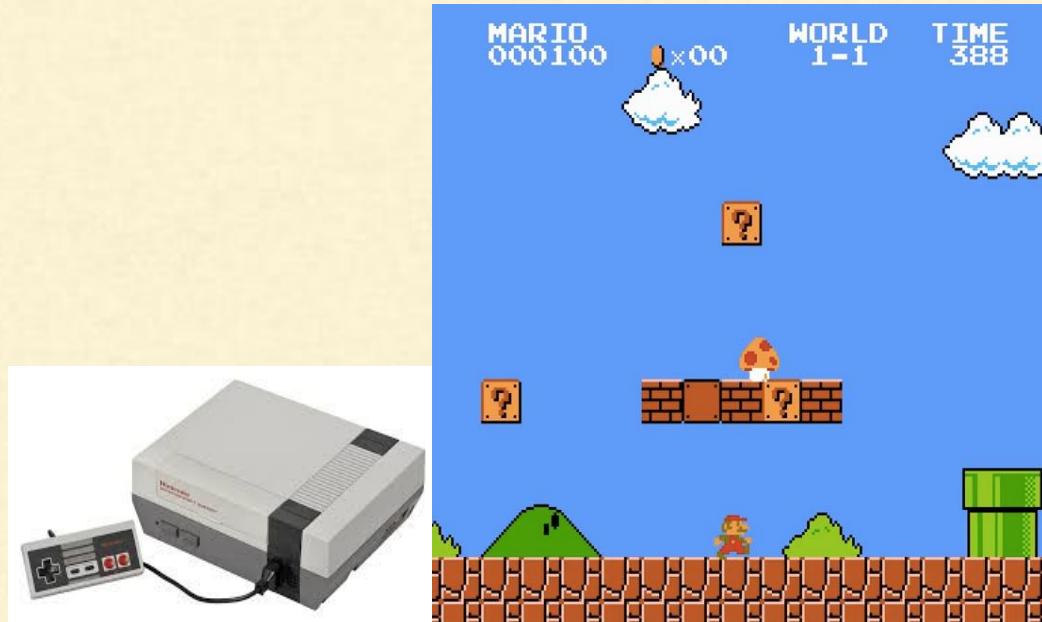
How About Automating it?

- Program Learns to Play Mario



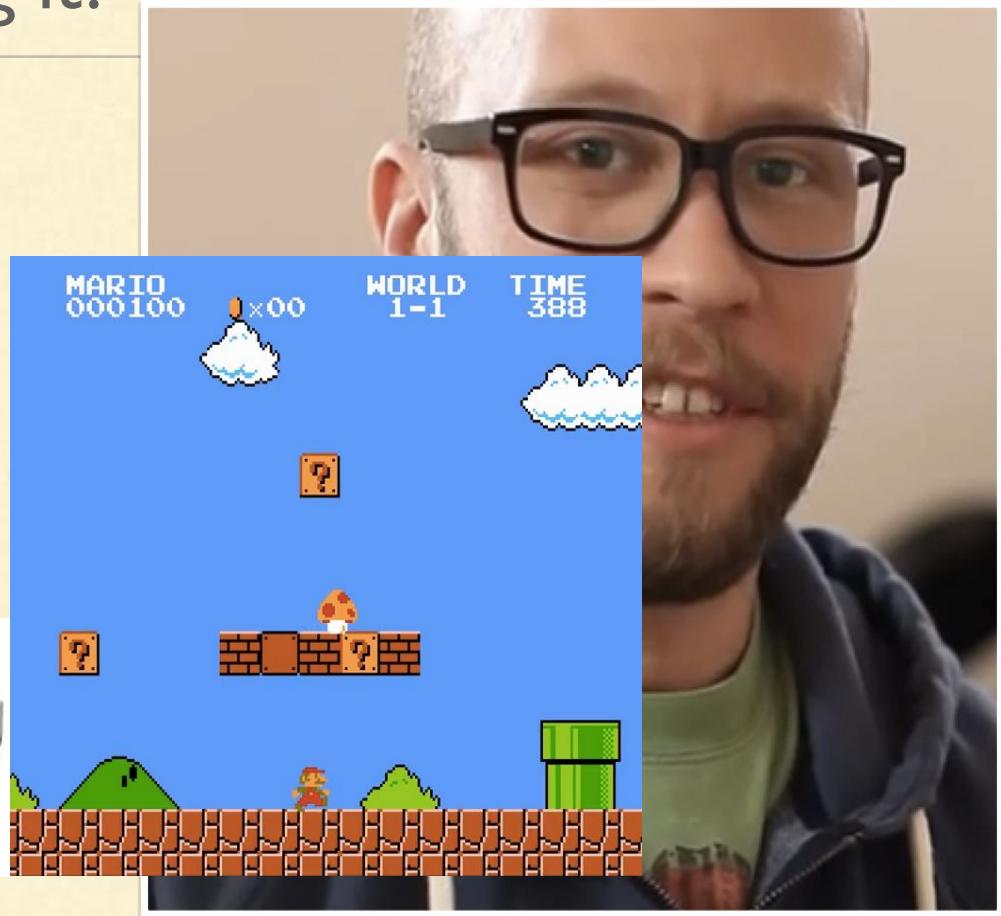
How About Automating it?

- Program Learns to Play Mario
- Observes the game & pressed keys



How About Automating it?

- Program Learns to Play Mario
- Observes the game & pressed keys
- Maximises Score



How About Automating it?



How About Automating it?

- So, the program learnt to play
 - Mario
 - And Other games
 - Without any programming



Question

To make this program learn any other games such as PacMan we will have to

1. Write new rules as per the game
2. Just hook it to new game and let it play for a while

Question

To make this program learn any other games such as PacMan we will have to

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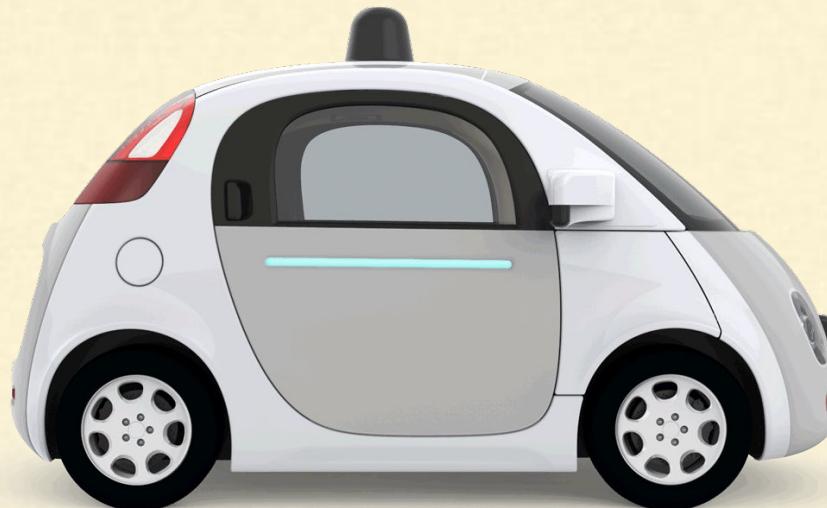
Imagine Doing The Same For Life



Gather data and automatically solve problems

The Machine Learning Tsunami - I

- Self driving cars on the roads



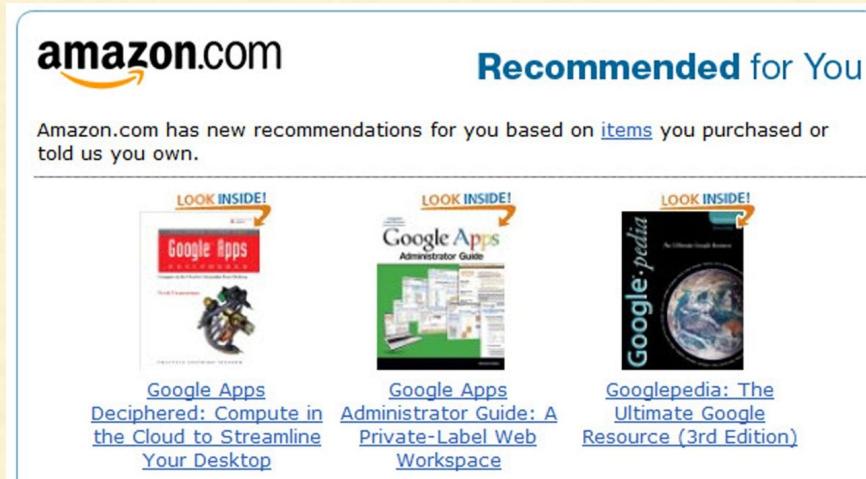
The Machine Learning Tsunami - 2

- Netflix movies recommendations



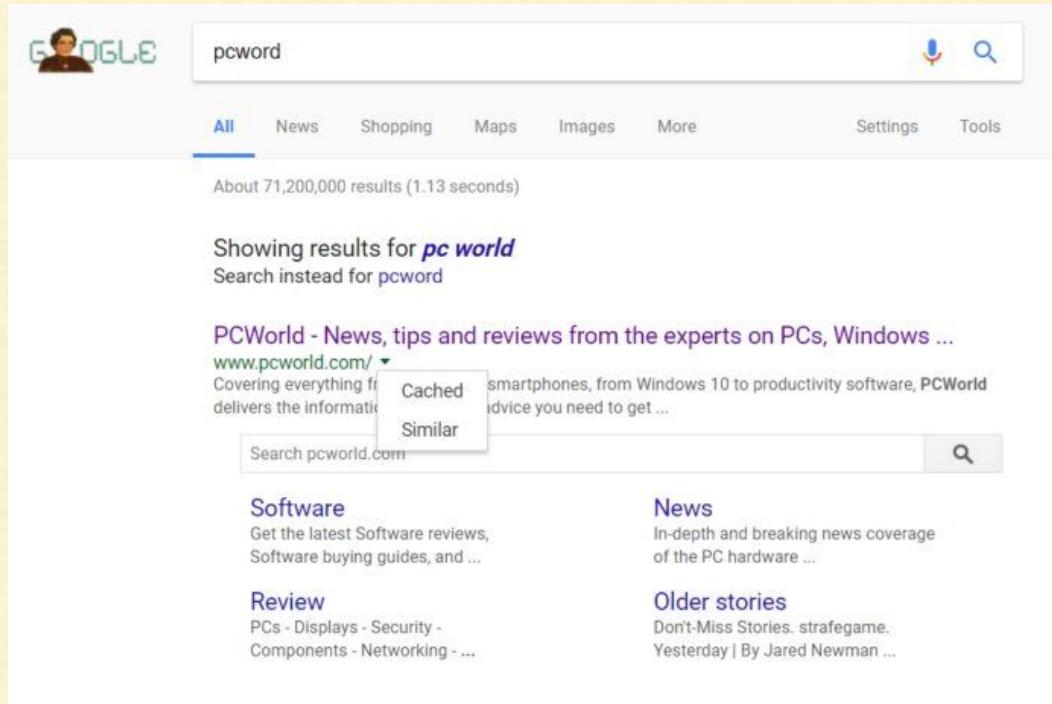
The Machine Learning Tsunami - 3

- Amazon product recommendations



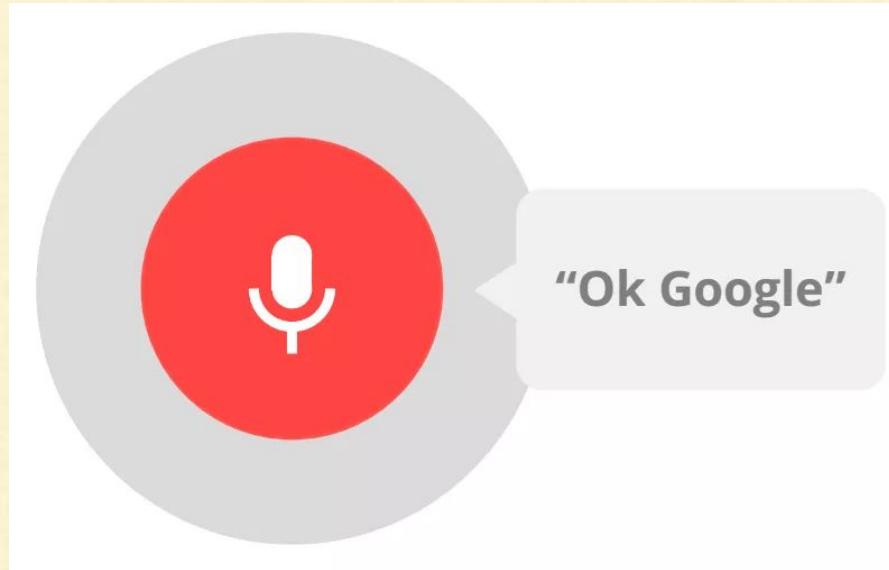
The Machine Learning Tsunami - 4

- Accurate results in Google Search



The Machine Learning Tsunami - 5

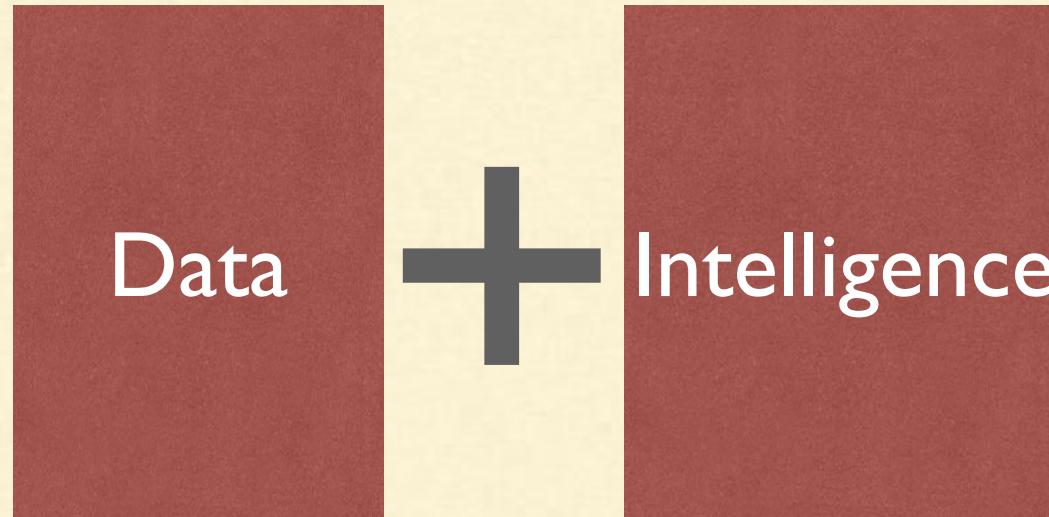
- Speech recognition in your smartphone



Question

What do we need to

- Gather Data
- And automatically solving the problem?



Gather Data



Collect Data - IOT



Phone & Devices

Cheaper, faster and smaller

Connectivity

Wifi, 4G, NFC, GPS

Process Data - Parallel Computing

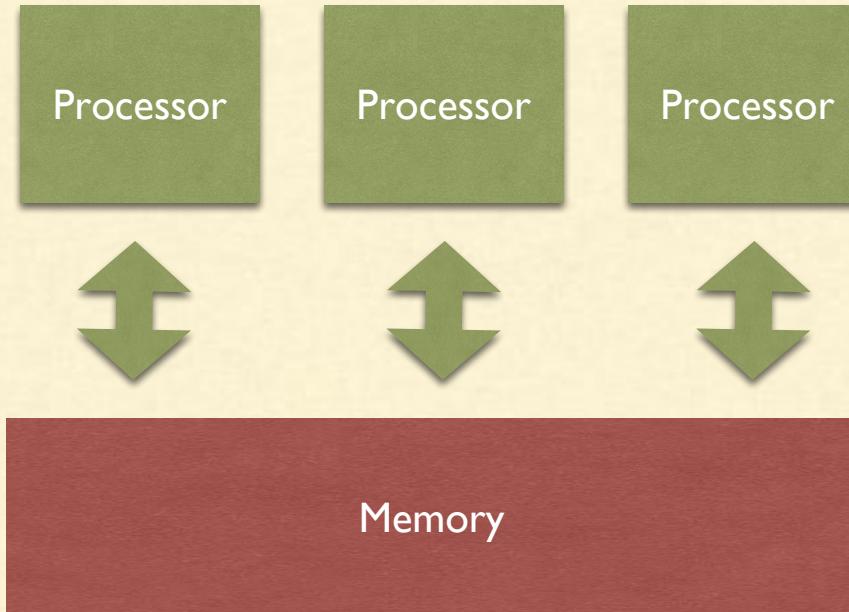
Distributed



- Groups of networked computers
- Interact with each other
- To achieve a common goal

Process Data - Parallel Computing

Multi Core + GPGPU (General Purpose Graphics Processing Units)



- Many processors or Cores
- Perform tasks and interact using
- Memory or bus

Process Data - Parallel Computing

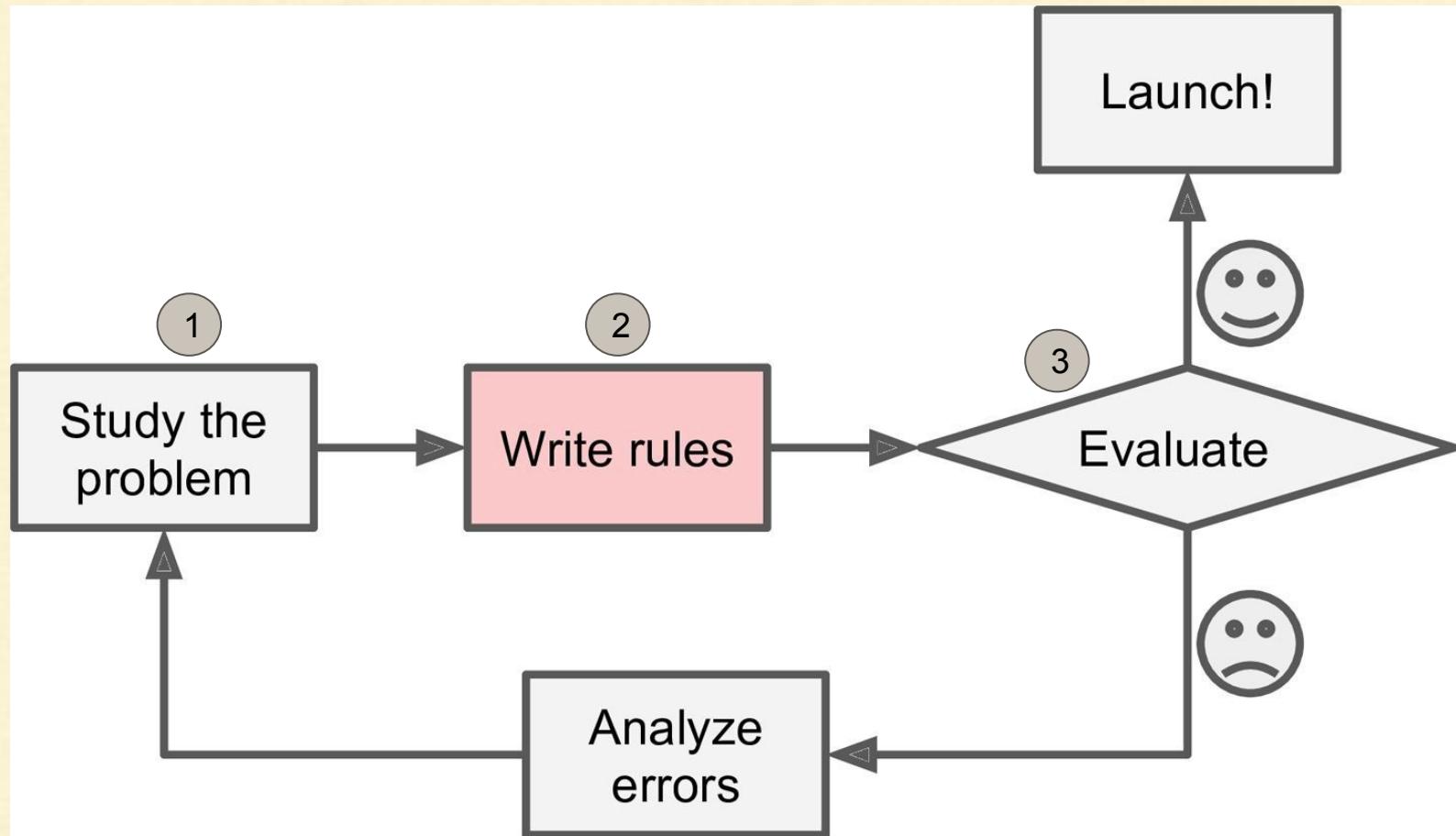
	MULTI CORE	GPGPU	DISTRIBUTED
CAN HANDLE HUGE DATA? (DISK READ INTENSIVE)			
REALLY FAST COMMUNICATION BETWEEN CPUS			
GREAT FOR MATHS/GRAFICS?			
TOOLS	Hadoop MR, Apache Spark	Keras, TensorFlow, Caffe, Spark (Exp)	Hadoop MR, Apache Spark

Intelligence - Traditional vs ML.



How you would write a spam filter?

Intelligence - Spam Filter - Traditional Approach



Intelligence - Spam Filter - Traditional Approach

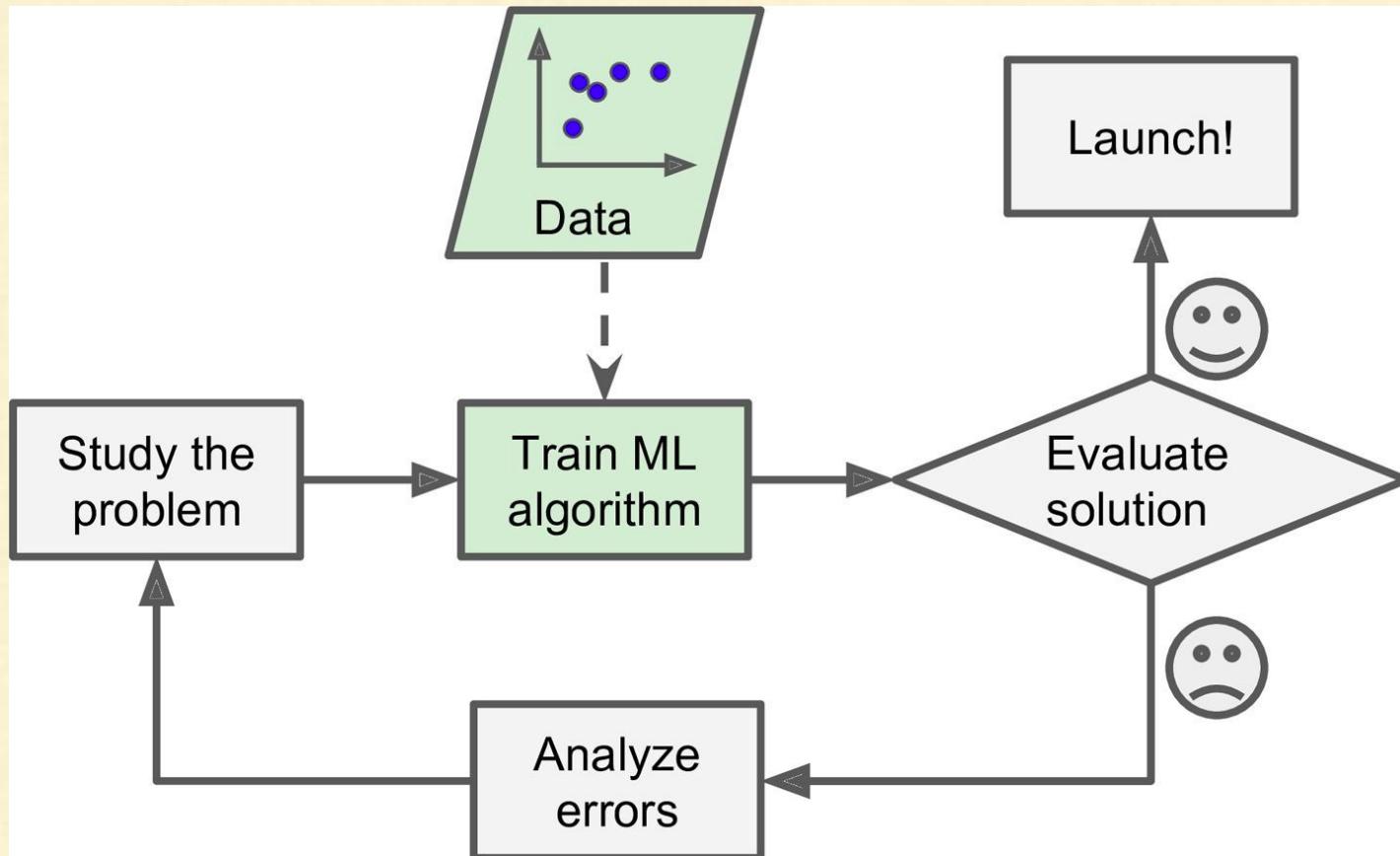
Problems?

Intelligence - Spam Filter - Traditional Approach

Problems?

- Problem is not trivial
 - Program will likely become a long list of complex rules
 - Pretty hard to maintain
- If spammers notice that
 - All their emails containing “**4U**” are blocked
 - They might start writing “**For U**” instead
 - If spammers keep working around spam filter, we will need to keep writing new rules forever

Intelligence - Spam Filter - ML Approach

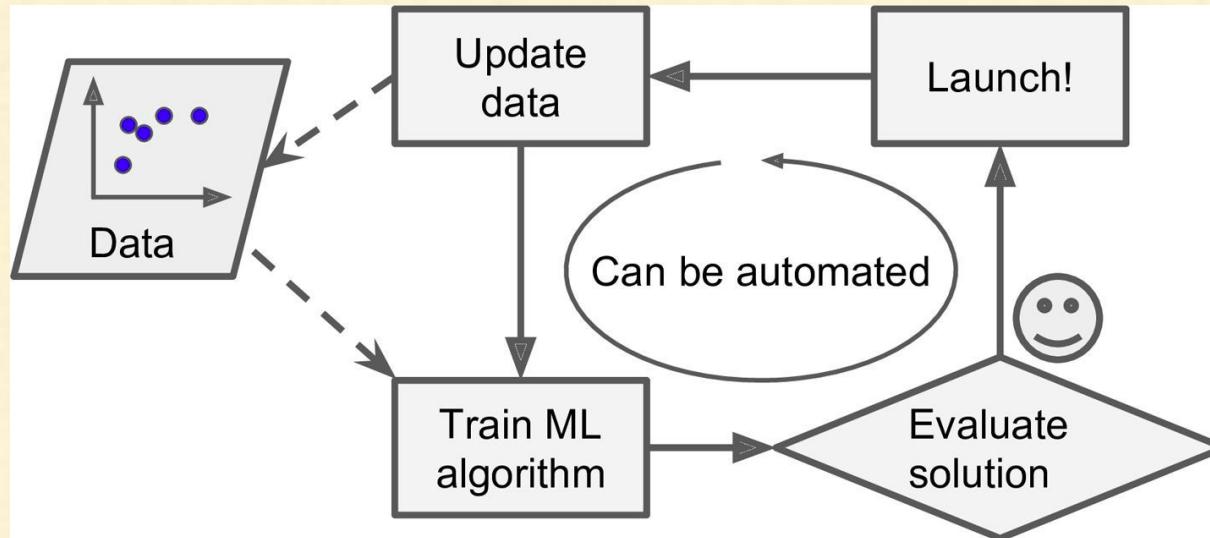


Intelligence - Spam Filter - ML Approach

- A spam filter based on Machine Learning techniques automatically learns
 - Which words and phrases are good predictors of spam
 - By detecting unusually frequent patterns of words
- The program will be
 - Much shorter
 - Easier to maintain
 - Most likely more accurate than traditional approach

Intelligence - Spam Filter - ML Approach

- Unlike traditional approach, ML techniques automatically notice that
 - “**For U**” has become unusually frequent in spam flagged by users and
 - It starts flagging them without our intervention



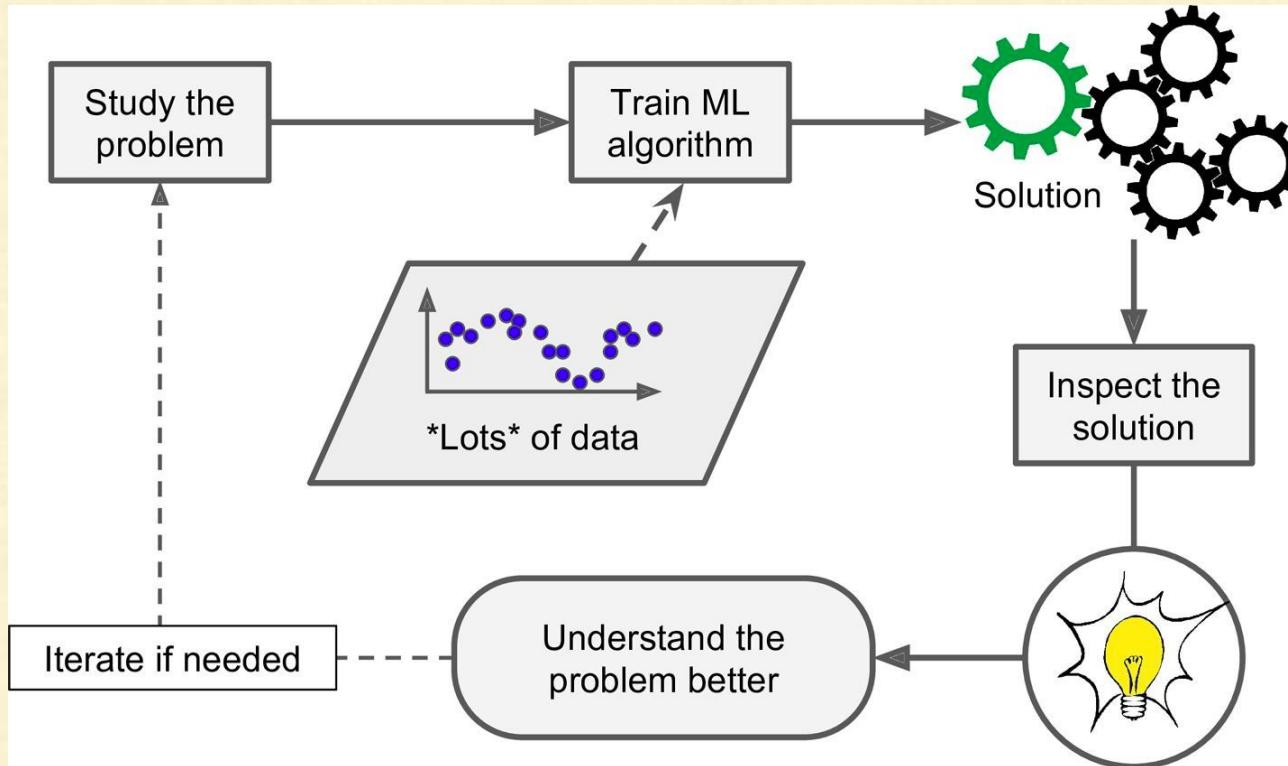
Intelligence - Spam Filter - ML Approach

Can help humans learn

- ML algorithms can be inspected to see what they have learned
- Spam filter after enough training
 - Reveals combinations of words that it believes are best predictors of spam
 - May reveal unsuspected correlations or new trend and
 - Lead to a better understanding of the problem for humans

Intelligence - Spam Filter - ML Approach

Can help humans learn

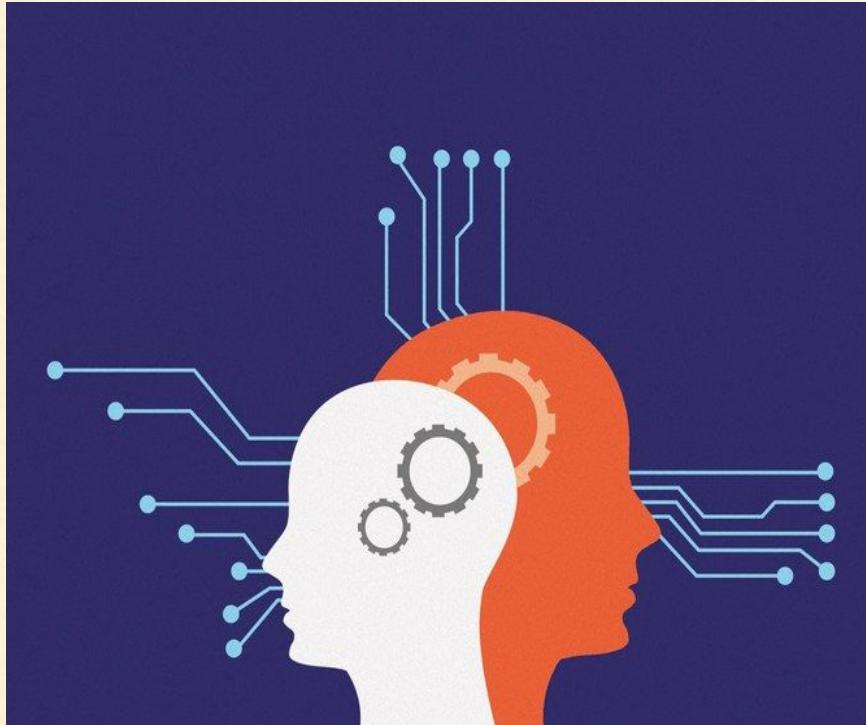


What is AI?

Artificial intelligence (AI):

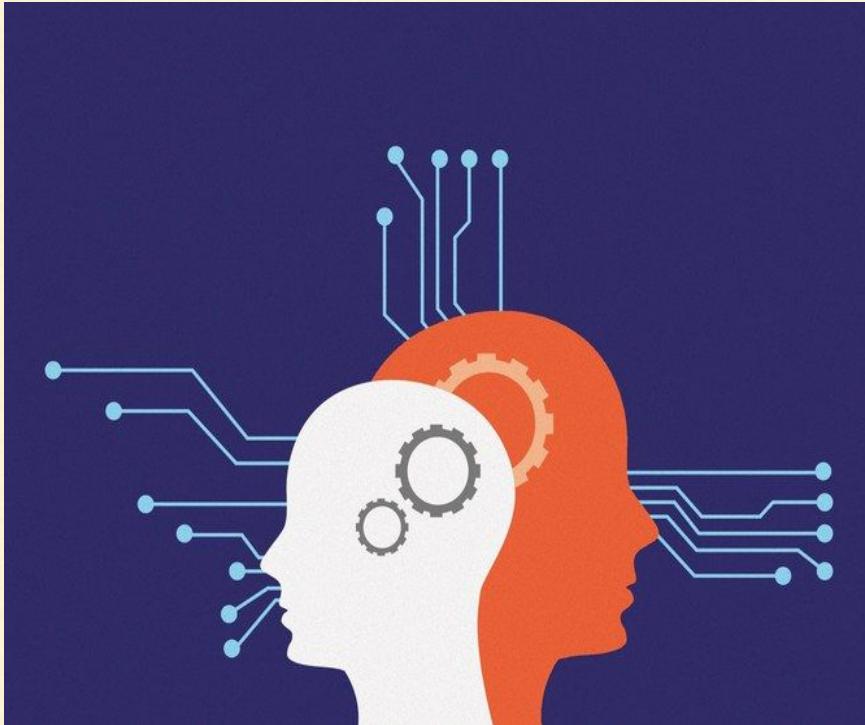
The intelligence exhibited by machines

What is AI?



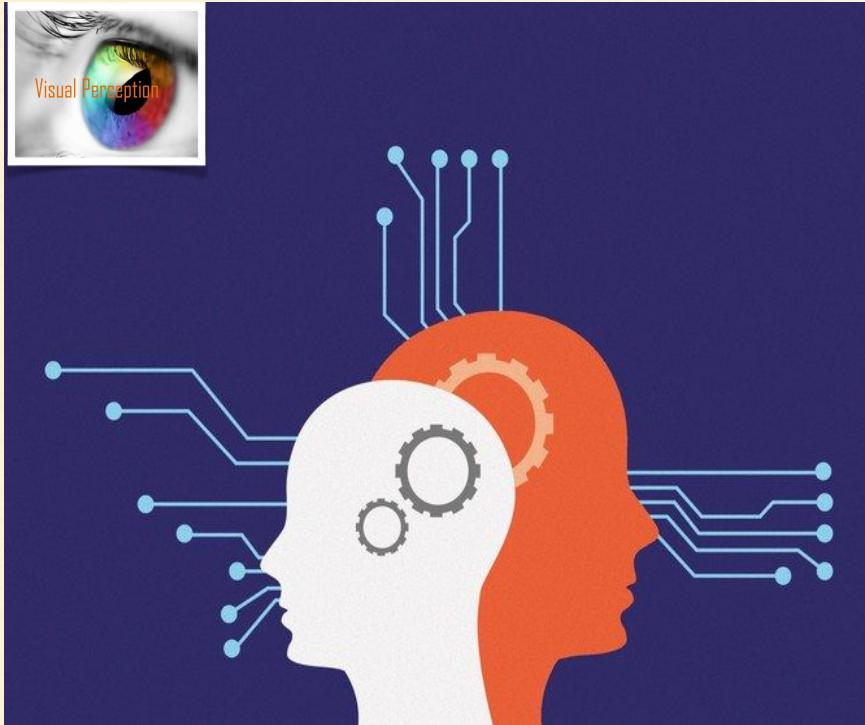
- The theory and development of computer systems

What is AI?



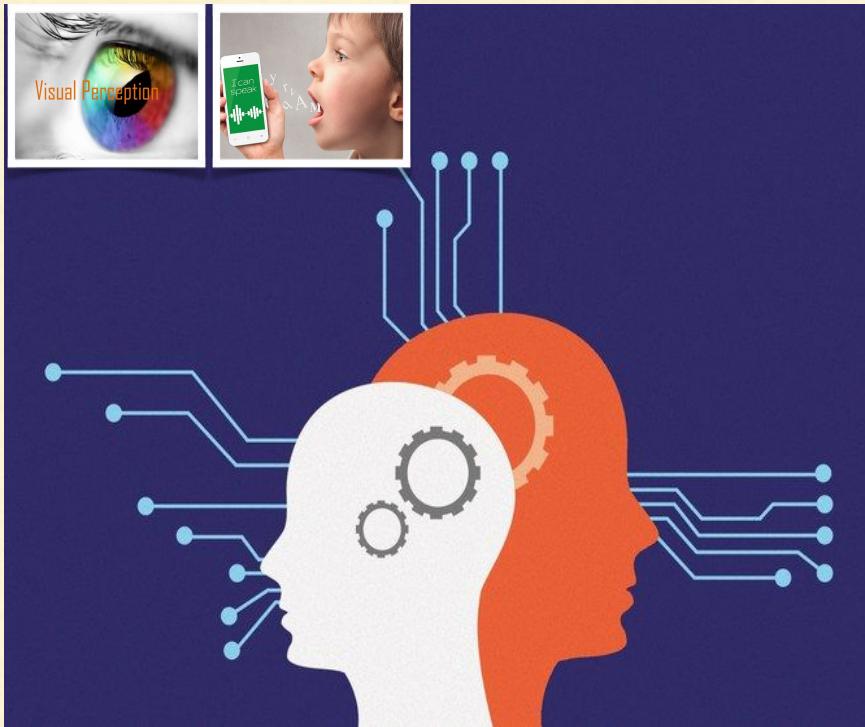
- The theory and development of computer systems
- To perform tasks requiring human intelligence such as

What is AI?



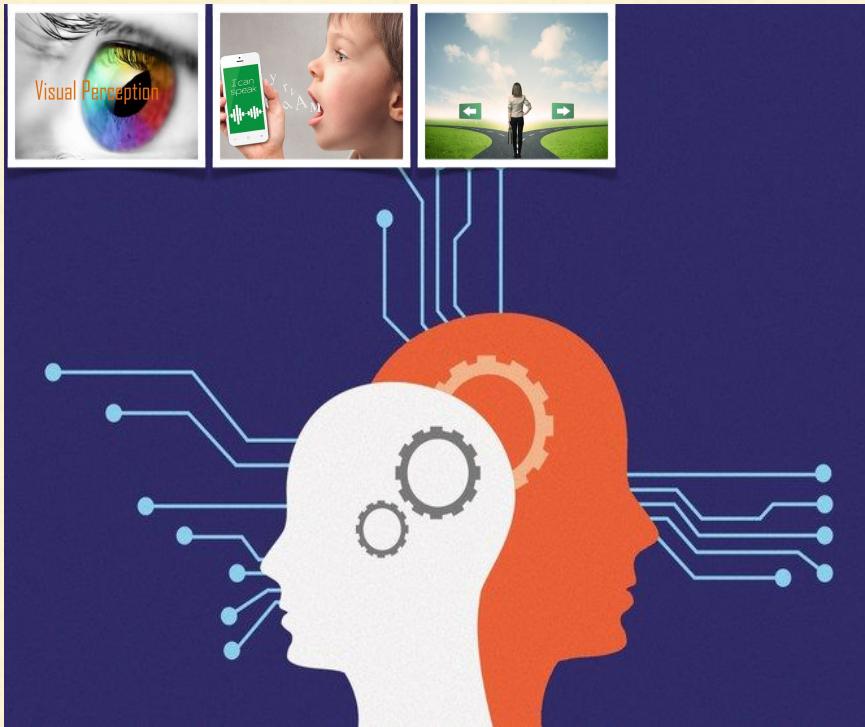
- The theory and development of computer systems
- To perform tasks requiring human intelligence such as
 - Visual perception

What is AI?



- The theory and development of computer systems
- To perform tasks requiring human intelligence such as
 - Visual perception
 - Speech Recognition

What is AI?



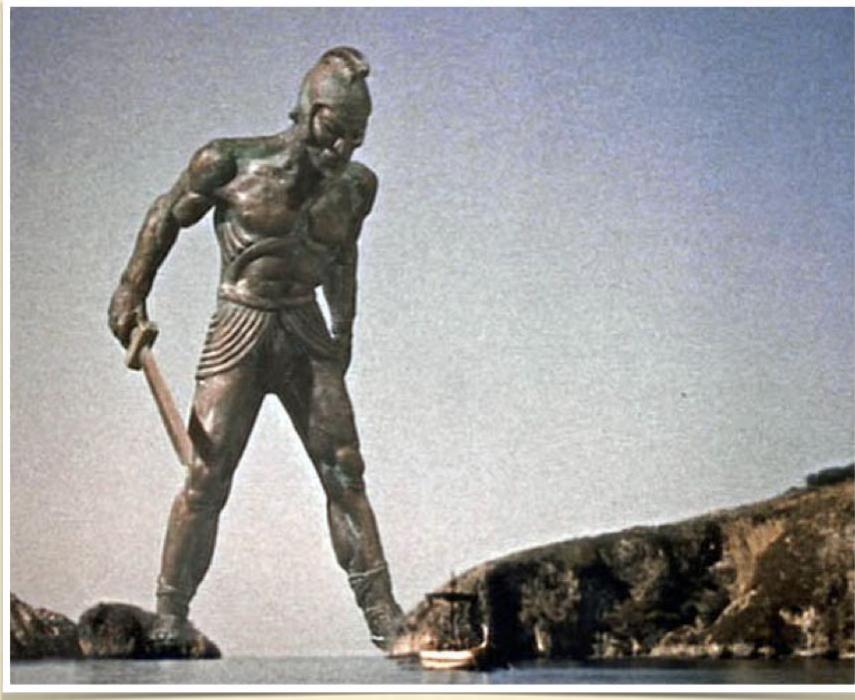
- The theory and development of computer systems
- To perform tasks requiring human intelligence such as
 - Visual perception
 - Speech Recognition
 - Decision Making

What is AI?



- The theory and development of computer systems
- To perform tasks requiring human intelligence such as
 - Visual perception
 - Speech Recognition
 - Decision Making
 - Translation between languages

History - Mythology / Fiction



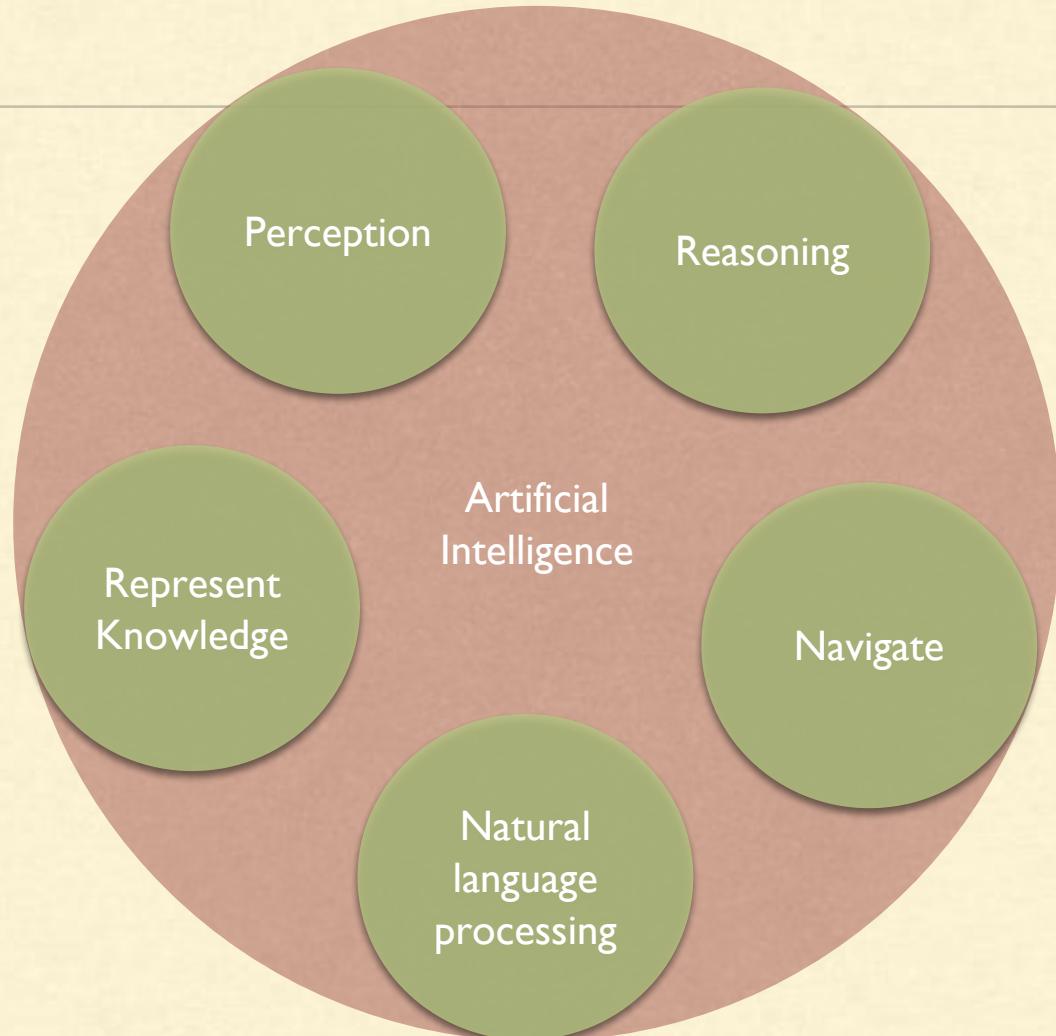
- In every mythology, there is some form of mechanical man such talos from greek mythology.
- In fiction novels, we have Mary Shelley's Frankenstein
- We are fascinated by the idea of creating things which can behave like human

History - Summer of 1956

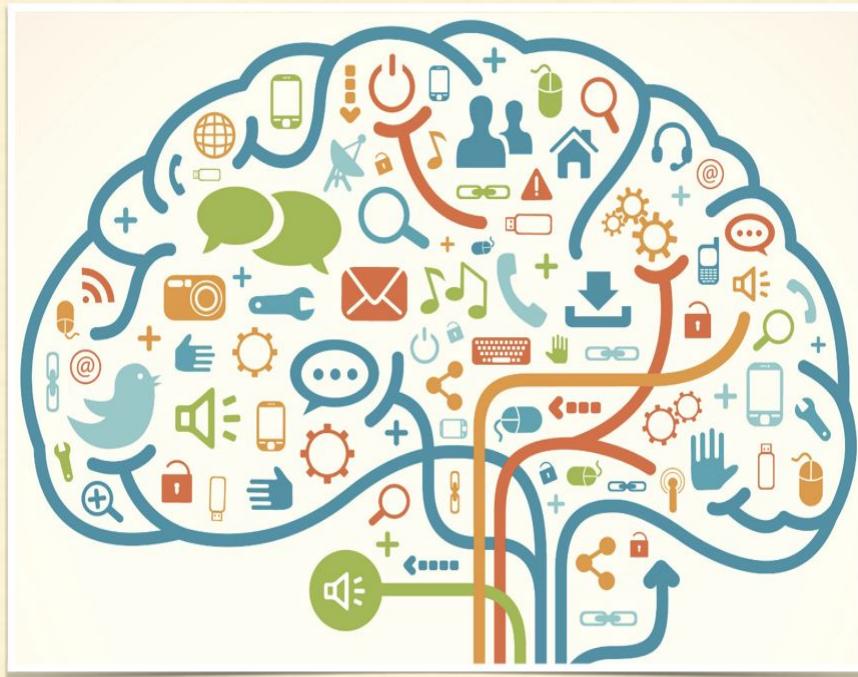


- The term artificial intelligence was coined by
 - John McCarthy
 - In a workshop at
 - Dartmouth College in New Hampshire
 - Along with Marvin Minsky, Claude Shannon, and Nathaniel Rochester

Sub-objectives of AI



AI - Represent Knowledge



- Understanding and classifying terms or things in world e.g.
 - What is computer?
 - What is a thought?
 - What is a tool?
 - Languages like **lisp** were created for the same purpose

AI - Reasoning



Aja Huang plays the first move for AlphaGo, against Lee Sedol 9 dan in game two.

- Play puzzle game - Chess, Go, Mario
- Prove Geometry theorems
- Diagnose diseases

AI - Navigate



- How to plan and navigate in the real world
- How to locate the destination?
- How to pick path?
- How to pick short path?
- How to avoid obstacles?
- How to move?

AI - Natural Language Processing



Ok Google - can you show me a list of your commands?

- How to speak a language
- How to understand a language
- How to make sense out of a sentence

AI - Perception



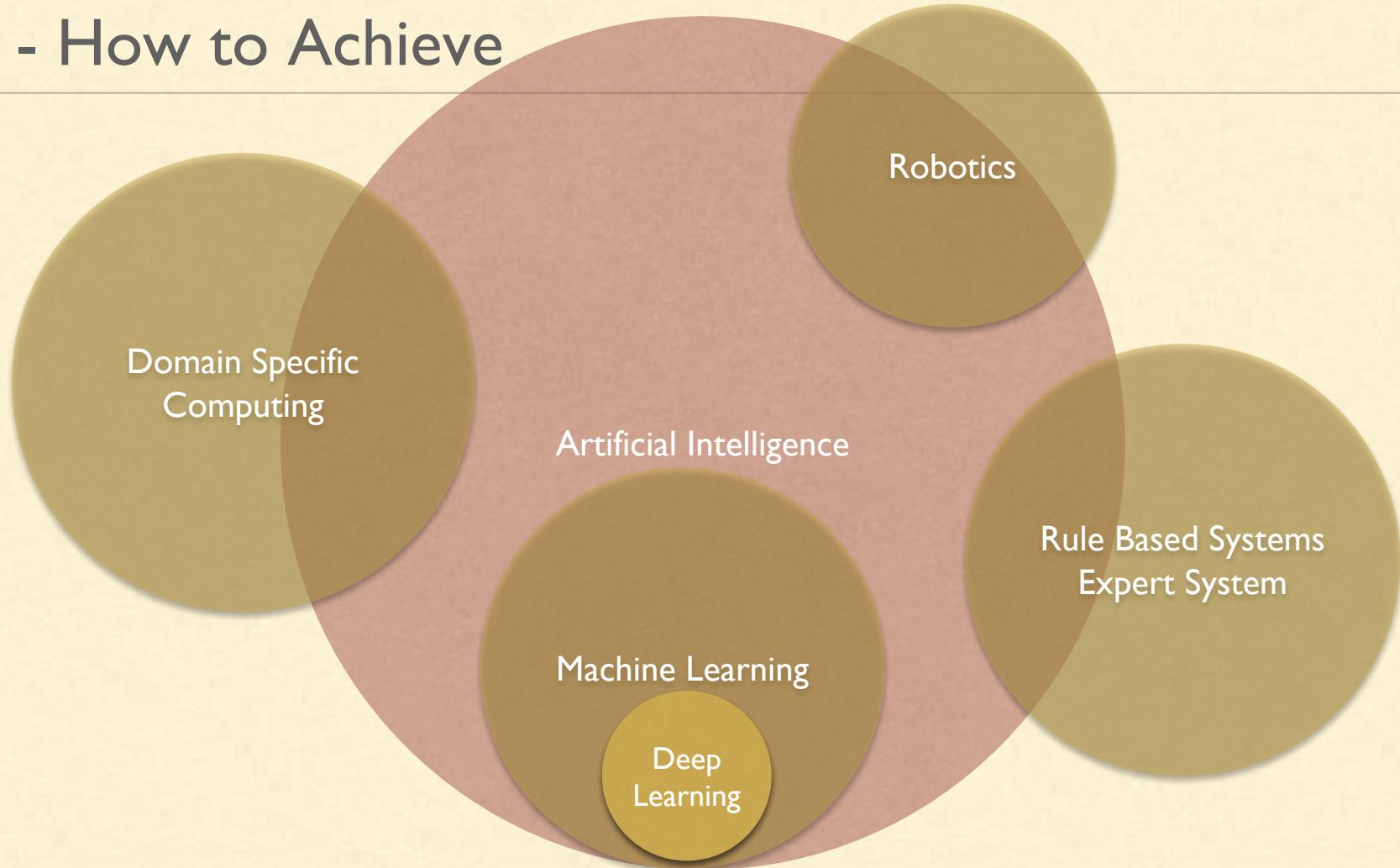
- How to we see things in the real world
- From sound, sight, touch, smell

AI - Generalised Intelligence

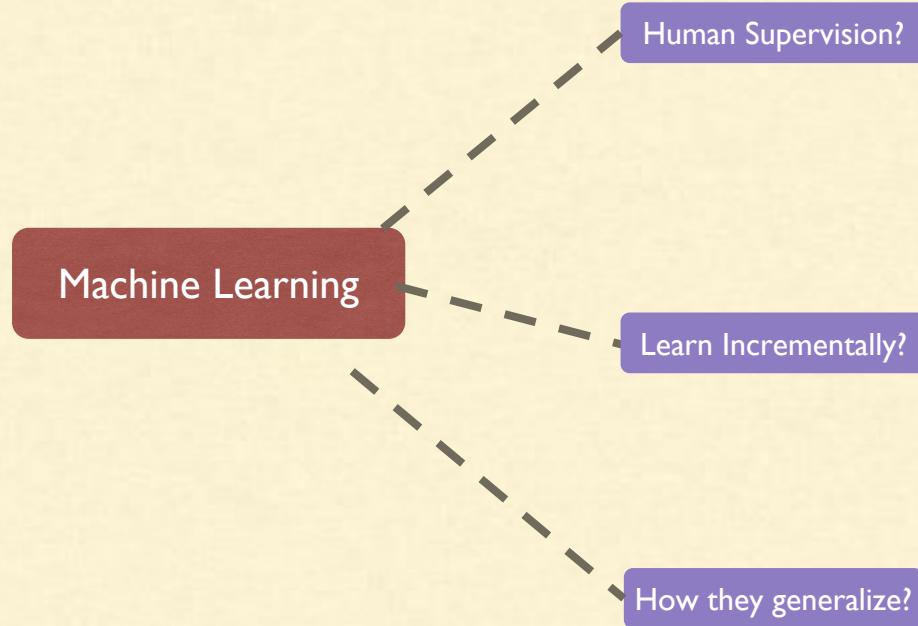


- With these previous building blocks, the following should emerge:
 - Emotional Intelligence
 - Creativity
 - Reasoning
 - Intuition

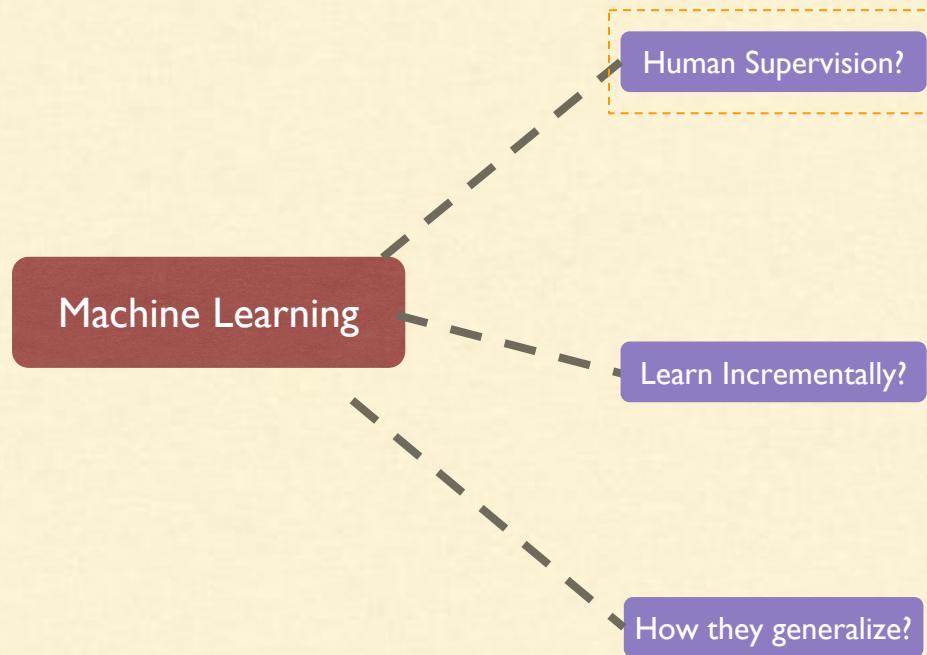
AI - How to Achieve



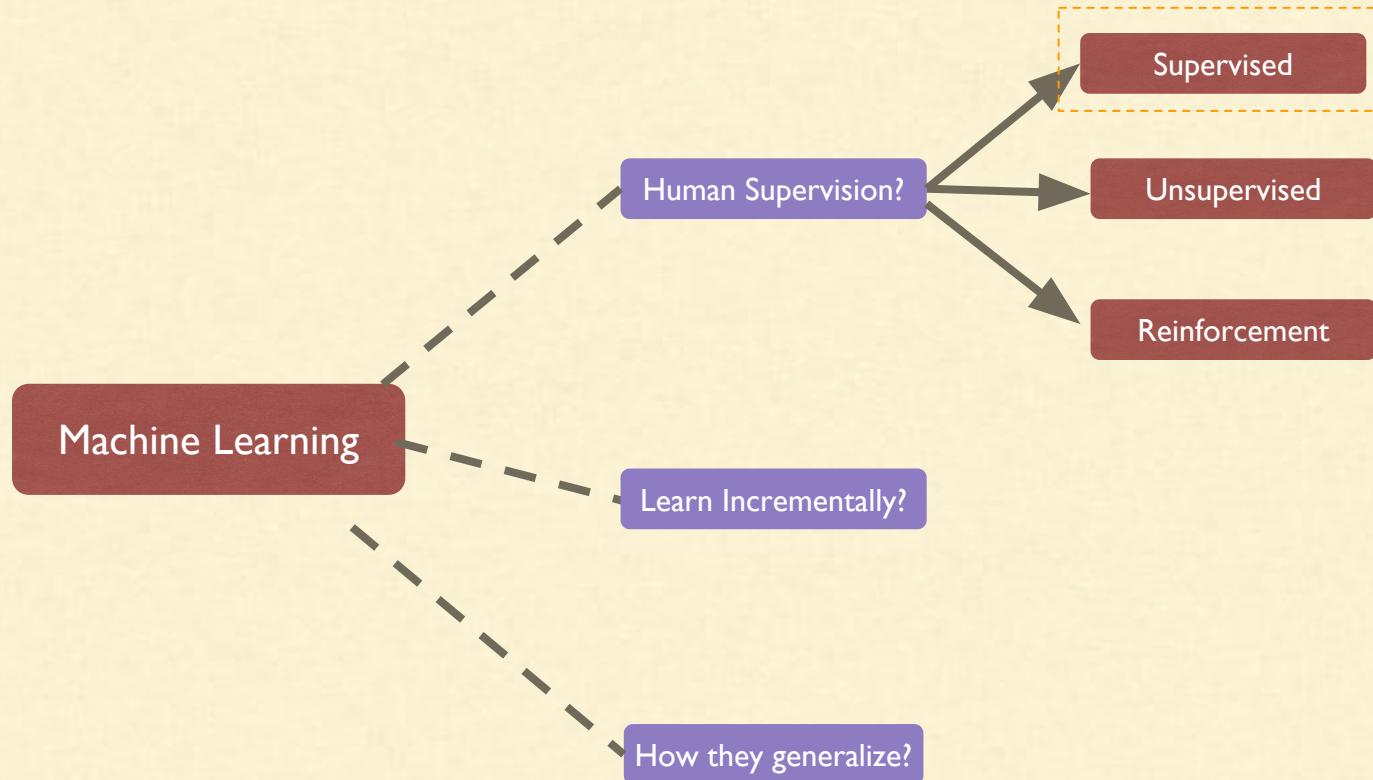
Machine Learning - Types



Machine Learning - Types



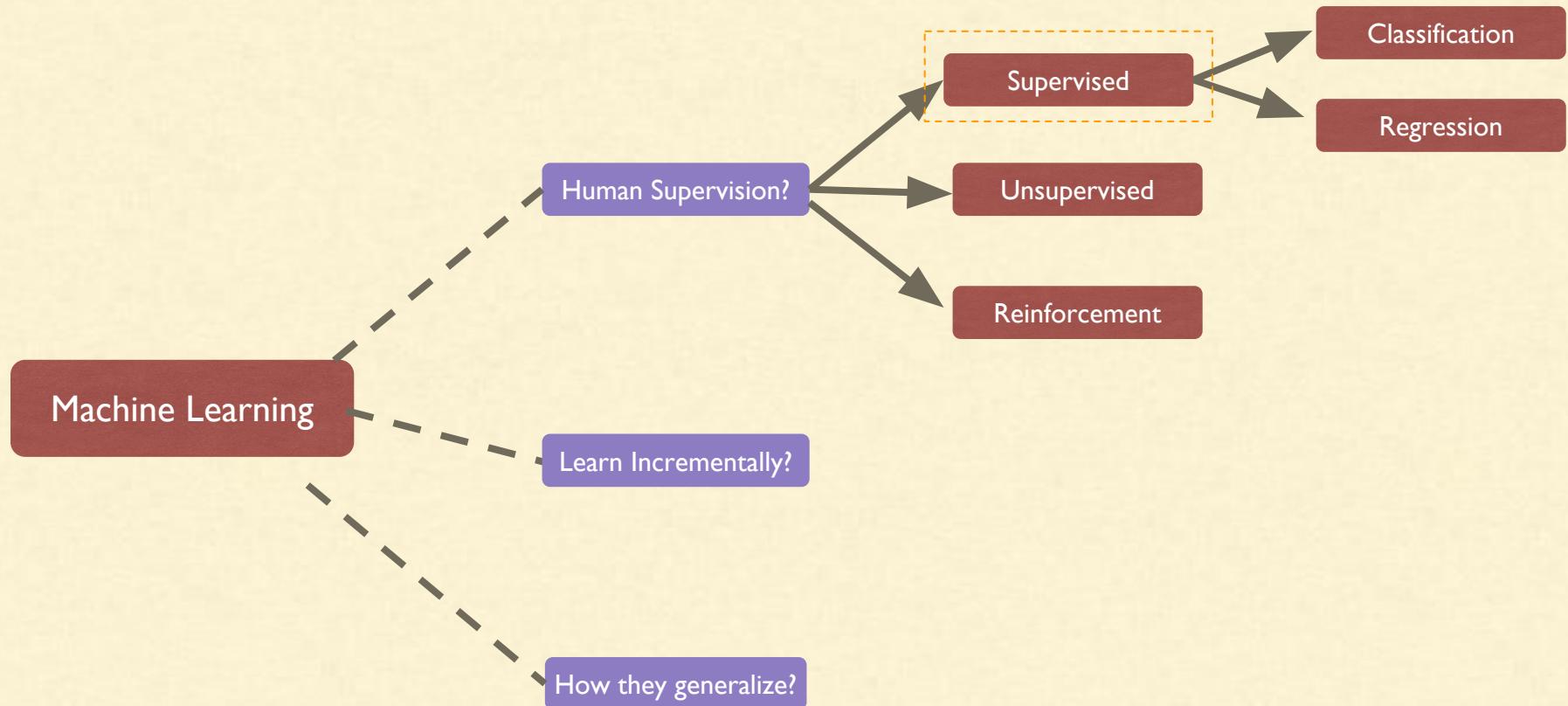
Machine Learning - Types



Machine Learning - Supervised Learning

Whether or not models are trained with human supervision

Machine Learning - Types



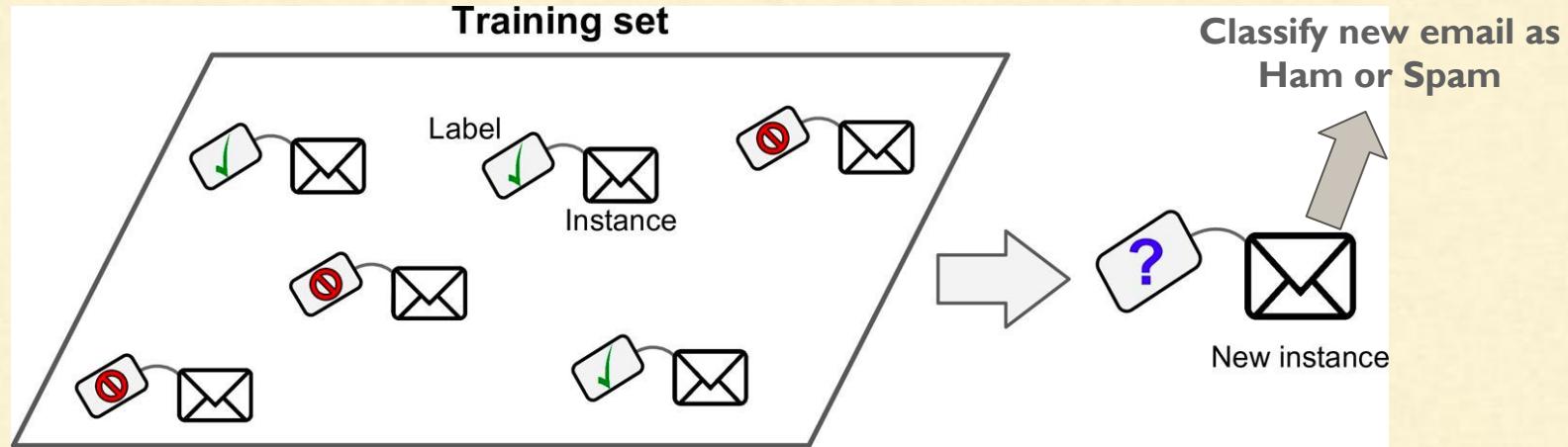
Machine Learning - Supervised Learning

Classification

- The training data we feed to the algorithm includes
 - The desired solutions, called labels
- Classification of **spam filter** is a supervised learning task

Machine Learning - Supervised Learning

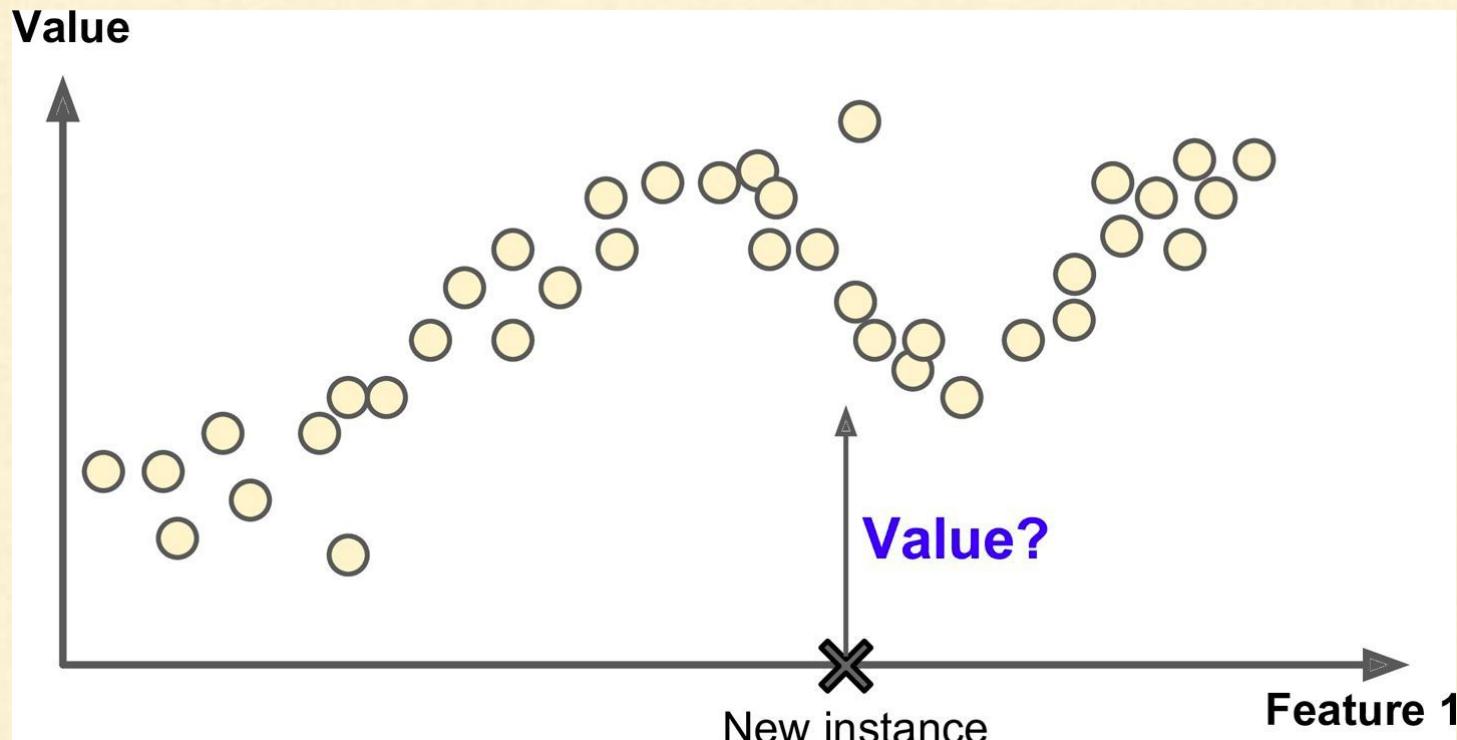
Classification



- Spam filter
 - Is trained with many example emails called training data.
 - Each email in the training data contains the label if it is spam or ham(not spam)
 - Models then learns to classify new emails if they are spam or ham

Machine Learning - Supervised Learning

Regression - Predict the price of the car (Value)

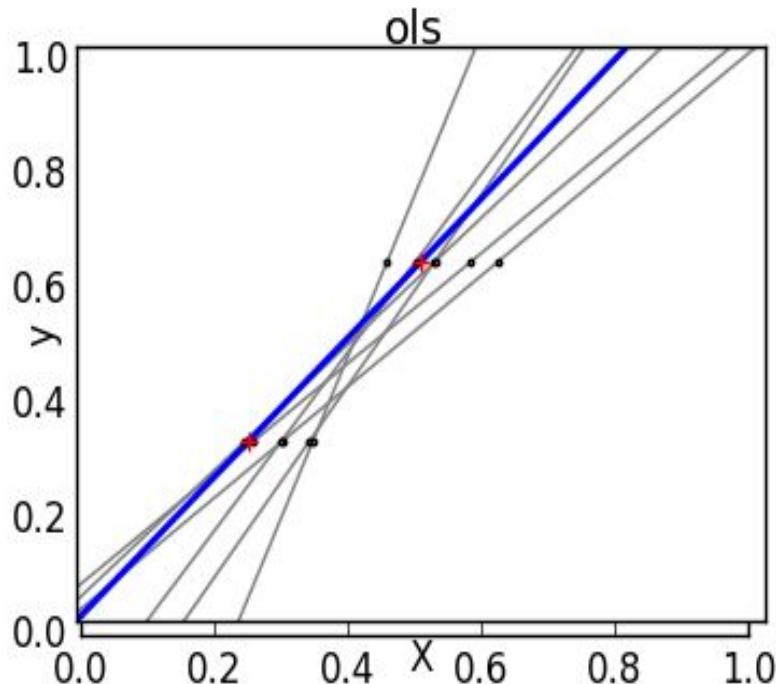


Machine Learning - Supervised Learning

Regression

- Predict price of the car
 - Given a set of features called predictors such as
 - Mileage, age, brand etc
- To train the model
 - We have to give many examples of cars
 - Including their predictors and labels(prices)

Machine Learning - Gradient Descent



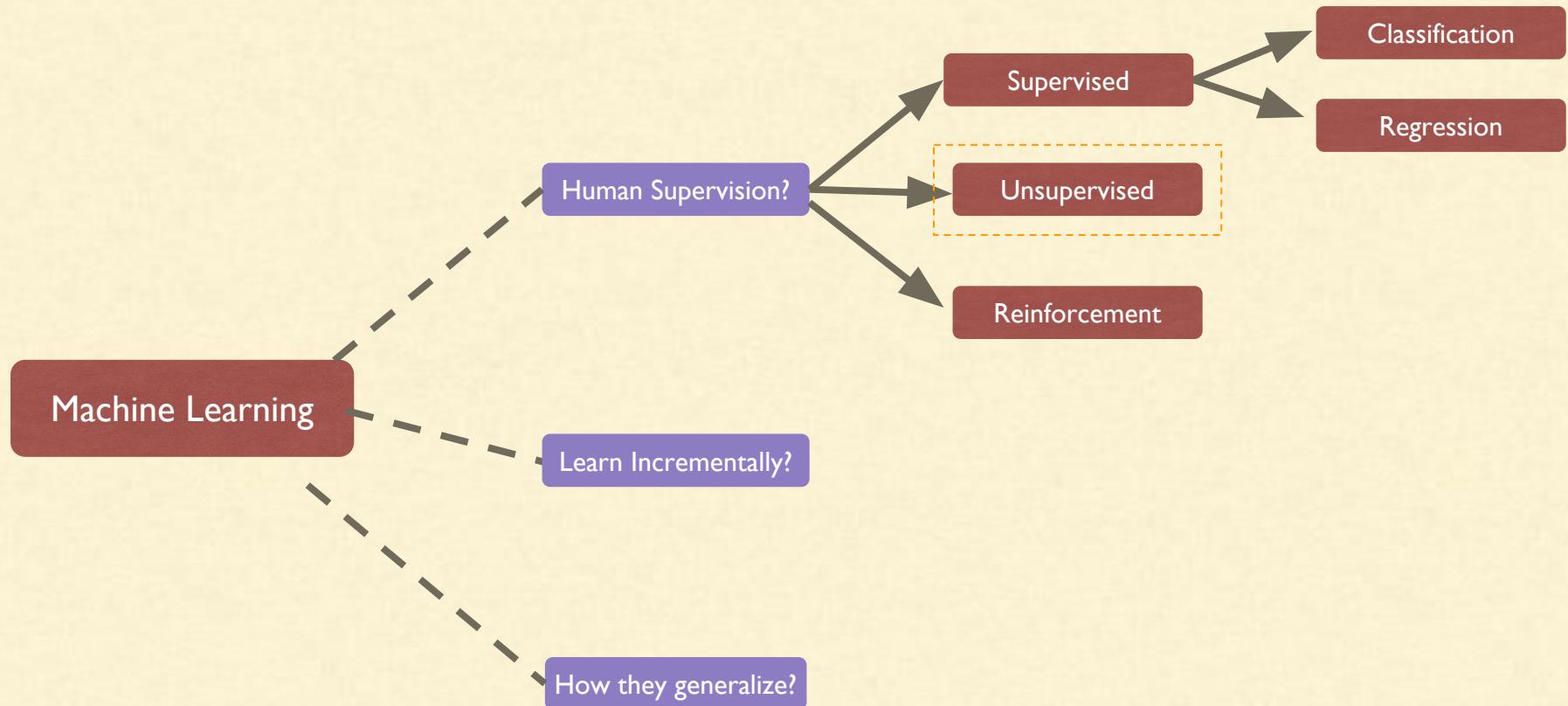
- Instead of trying all lines, go into the direction yielding better results

Machine Learning - Gradient Descent



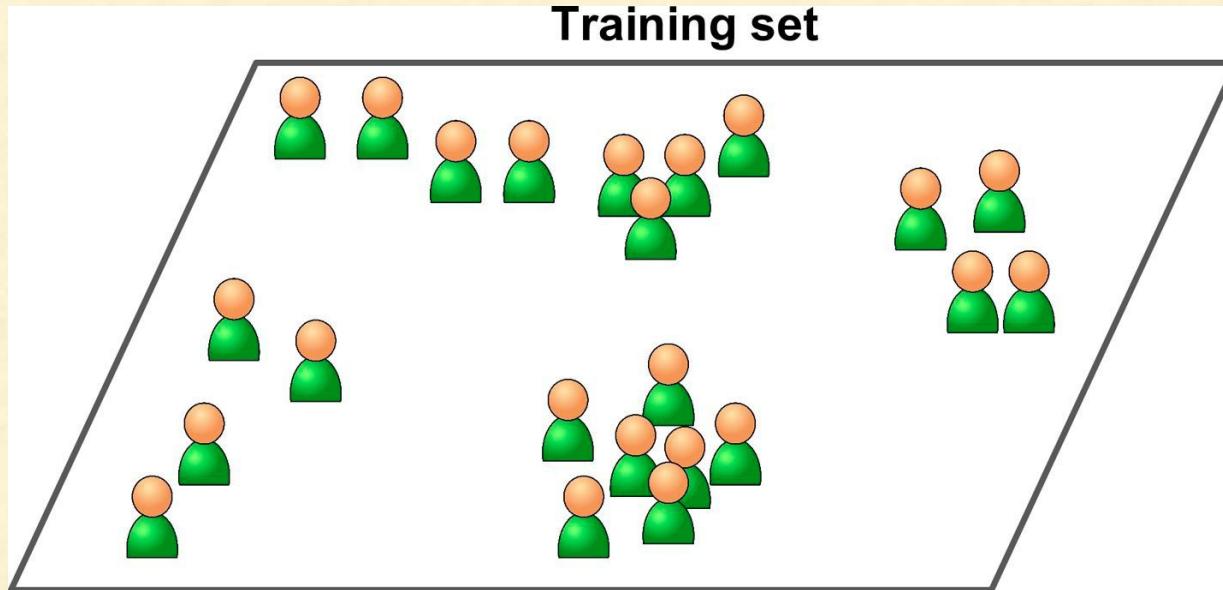
- Imagine yourself blindfolded on the mountainous terrain
- And you have to find the best lowest point
- If your last step went higher, you will go in opposite direction
- Other, you will keep going just faster

Machine Learning - Types

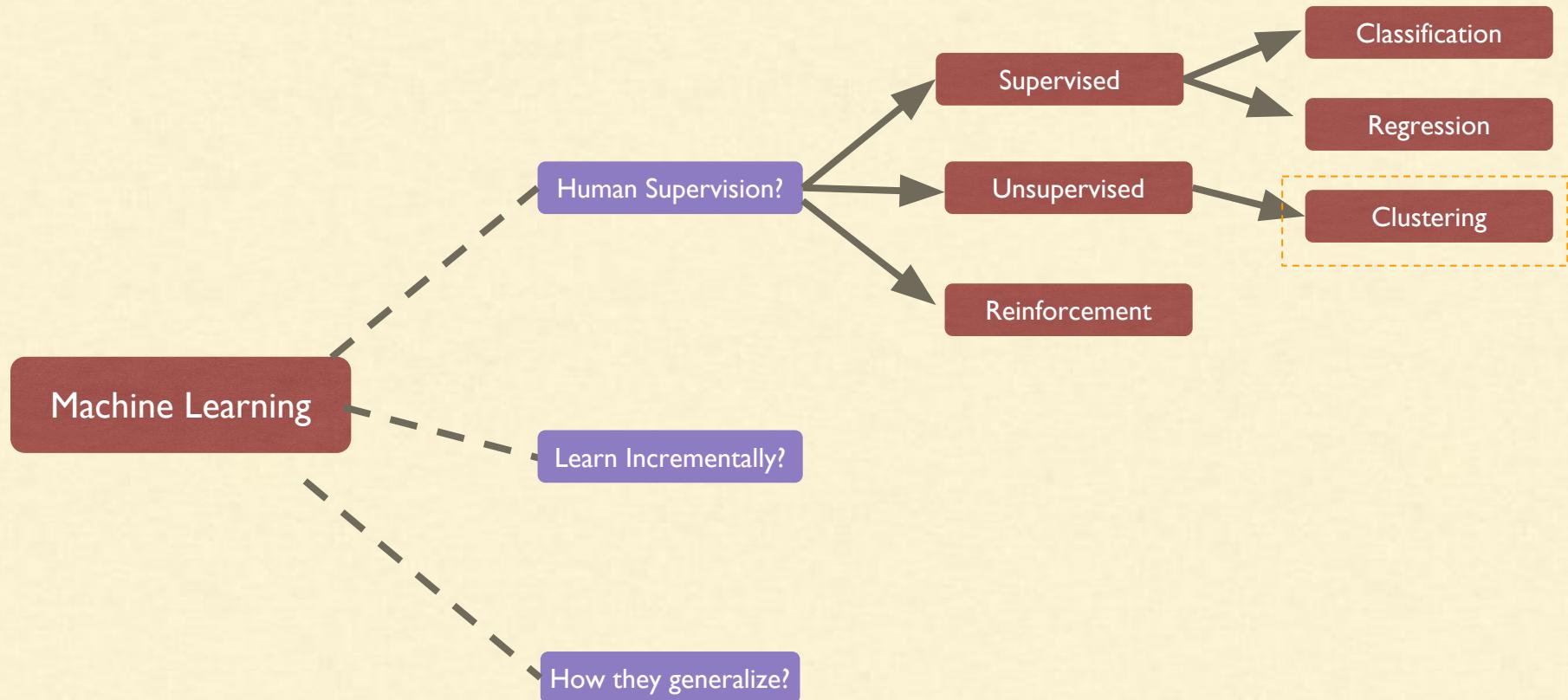


Machine Learning - Unsupervised Learning

- The training data is unlabeled
- The system tries to learn without a teacher

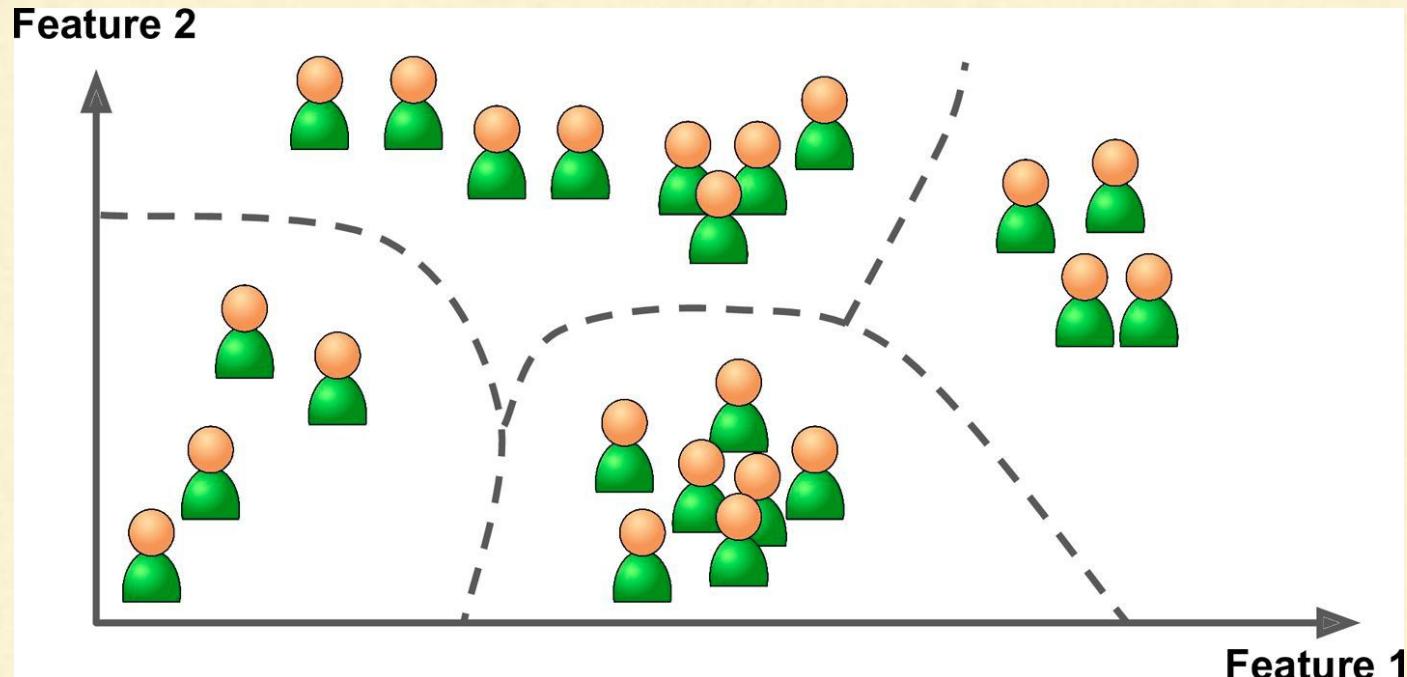


Machine Learning - Types



Machine Learning - Unsupervised Learning

Clustering - Detect group of similar visitors in your blog



Machine Learning - Unsupervised Learning

Clustering

- Detect group of similar visitors in blog
 - Notice the training set is unlabeled
- To train the model
 - We just feed the training set to clustering algorithm
 - At no point we tell the algorithm which group a visitor belongs to
 - It find groups without our help

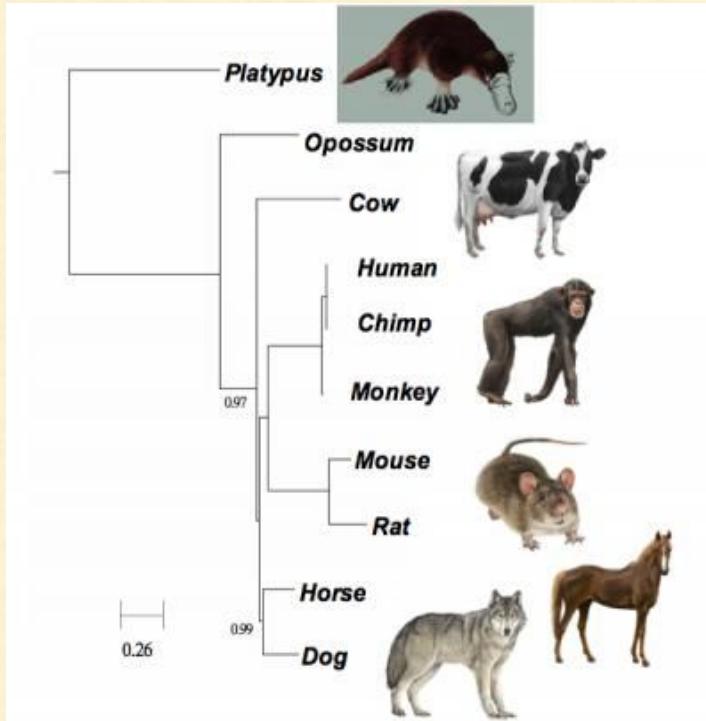
Machine Learning - Unsupervised Learning

Clustering

- It may notice that
 - 40% visitors are comic lovers and read the blog in evening
 - 20% visitors are sci-fi lovers and read the blog during weekends
- This data helps us in targeting our blog posts for each group

Machine Learning - Unsupervised Learning

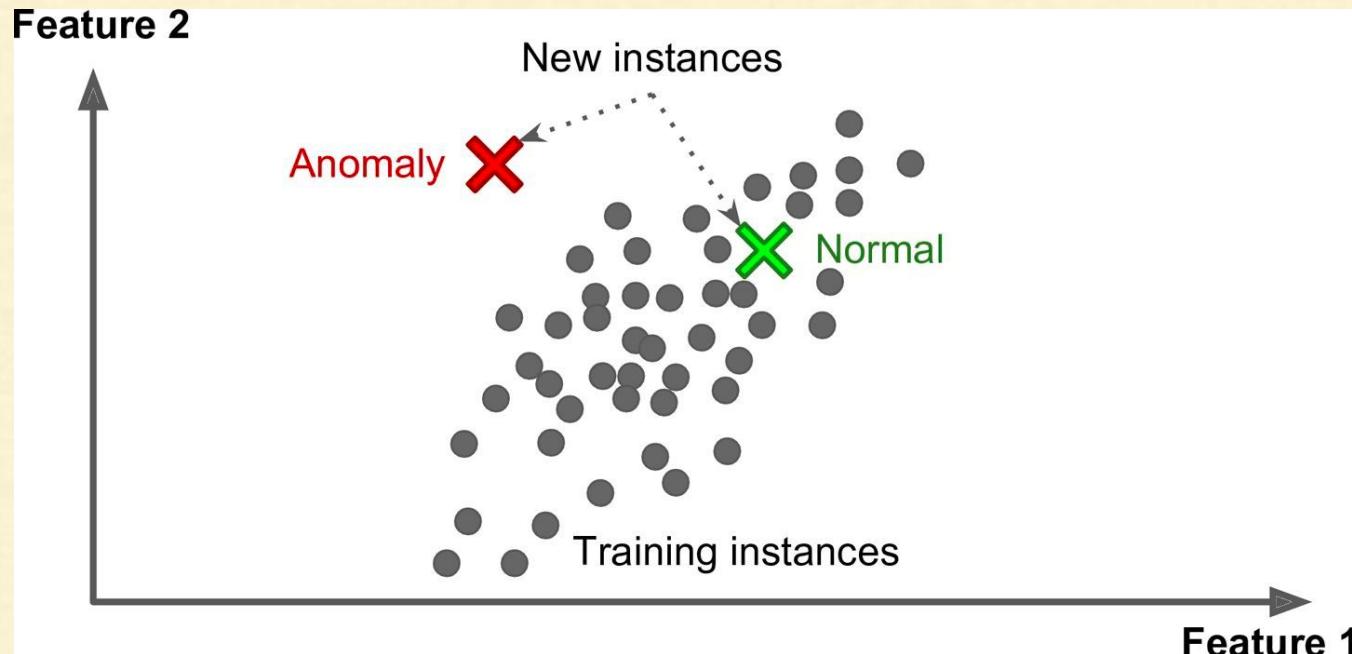
Hierarchical Clustering - Bring similar elements together



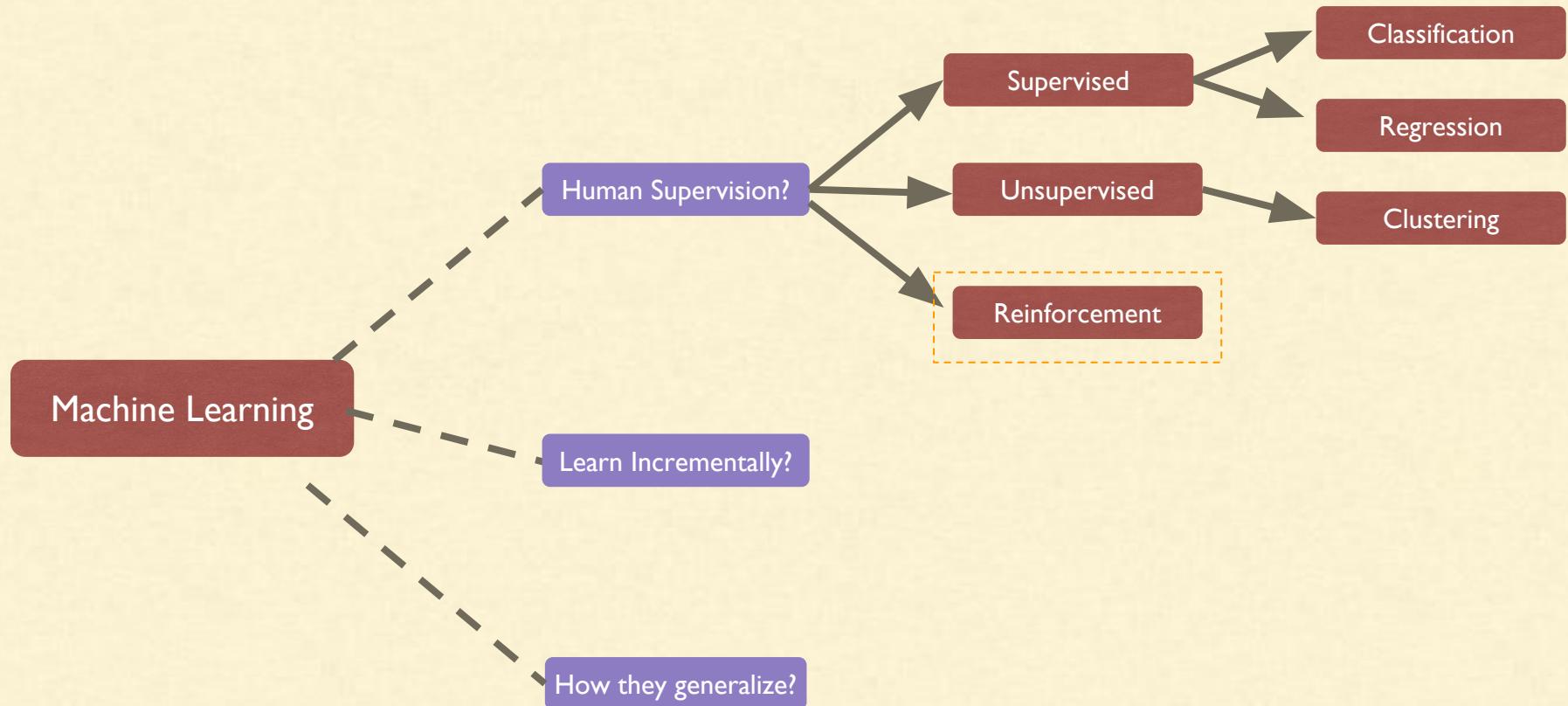
- In the form of a tree
- Nodes closer to each other are similar

Machine Learning - Unsupervised Learning

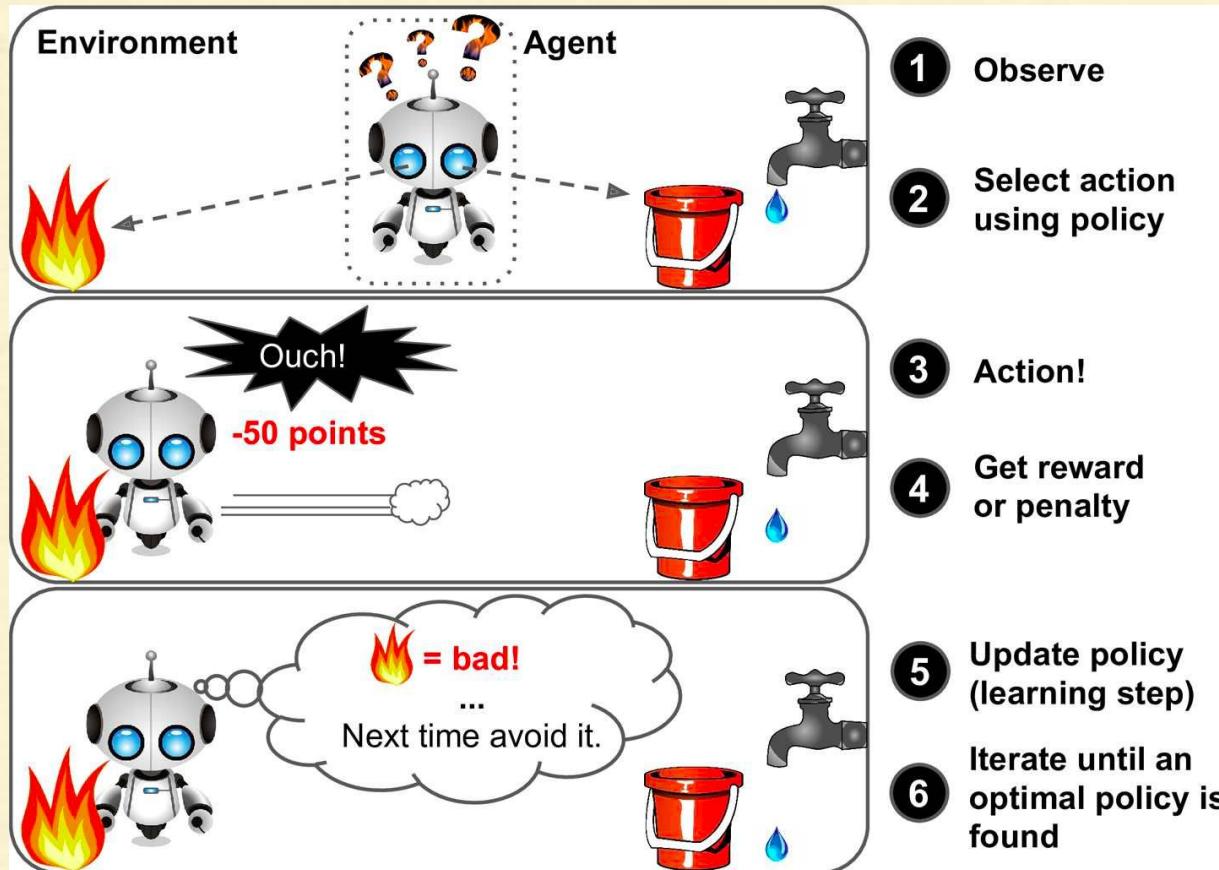
Anomaly Detection - Detecting unusual credit card transactions to prevent fraud



Machine Learning - Types



Machine Learning - Reinforcement Learning



Machine Learning - Reinforcement Learning

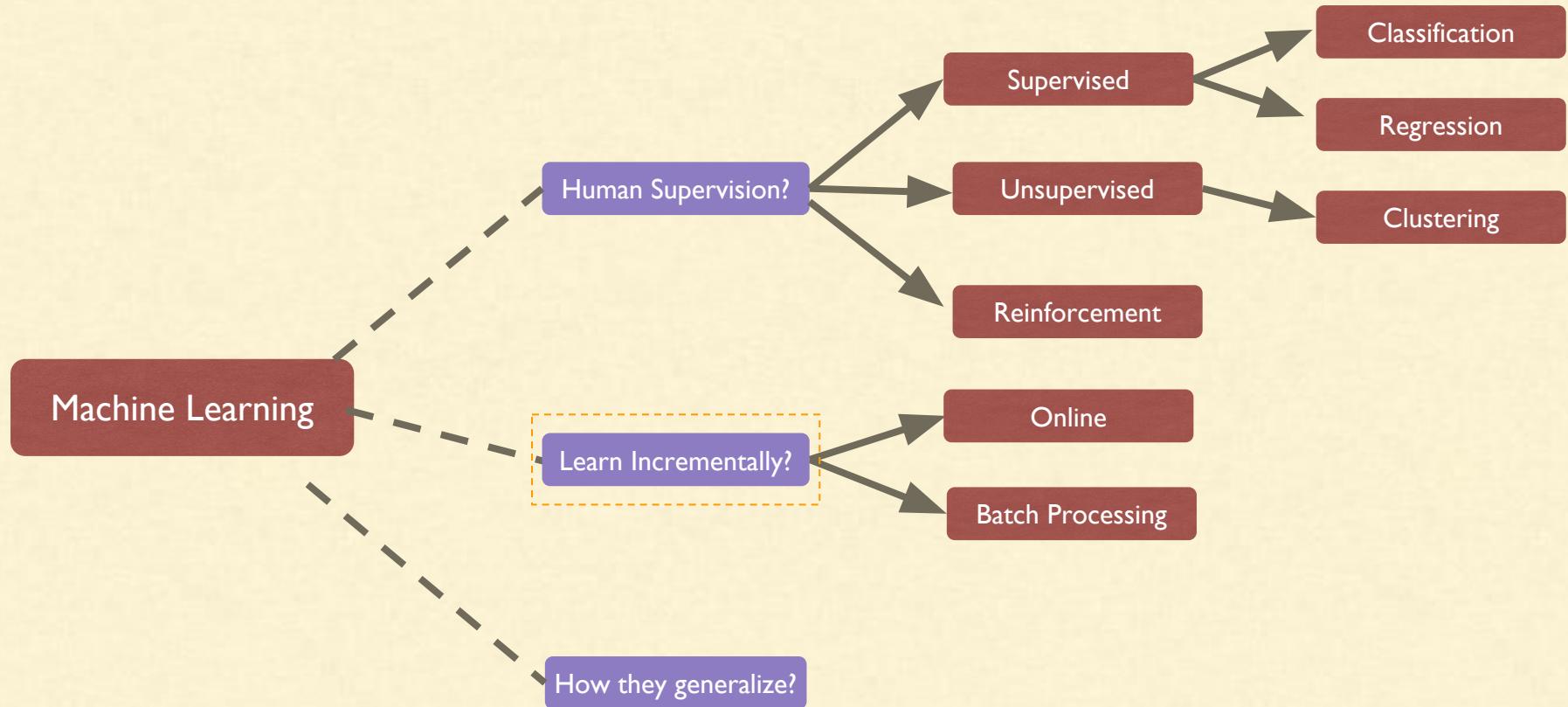
- The learning system an agent in this context
 - Observes the environment
 - Selects and performs actions and
 - Get rewards or penalties in return
 - Learns by itself what is the best strategy (policy) to get most reward over time

Machine Learning - Reinforcement Learning

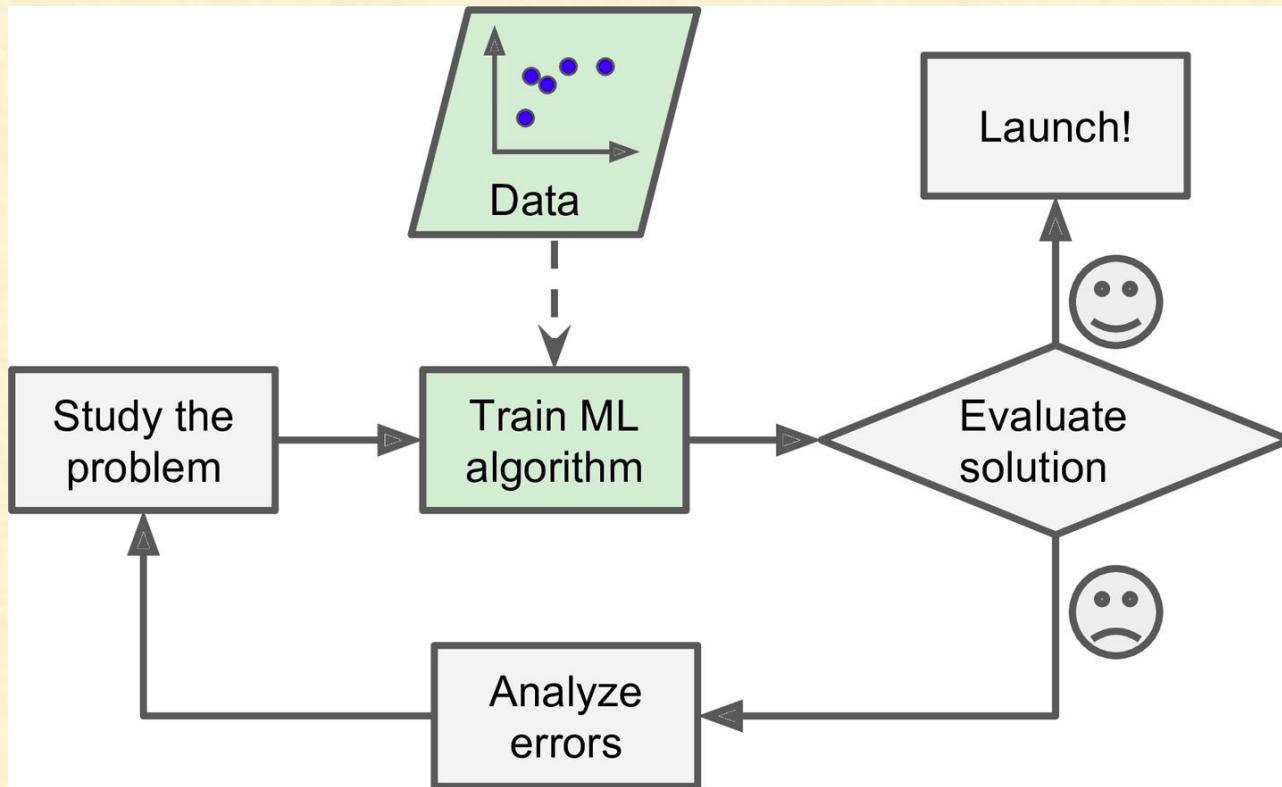
Applications

- Used by robots to learn how to walk
- DeepMind's AlphaGo
 - Which defeated world champion Lee Sedol at the game of Go

Machine Learning - Types



Machine Learning - Batch Learning



Machine Learning - Batch Learning

- Offline learning
- System is incapable of learning incrementally
 - It must be trained offline using all the available data
- Takes lot of time and computing resources
 - everytime training happens on the entire data

Machine Learning - Batch Learning

- Once the system is trained, it gets
 - Pushed to production
 - Runs without learning anymore
 - Just applies what it has learned offline

Machine Learning - Batch Learning

How to train the system with new data?

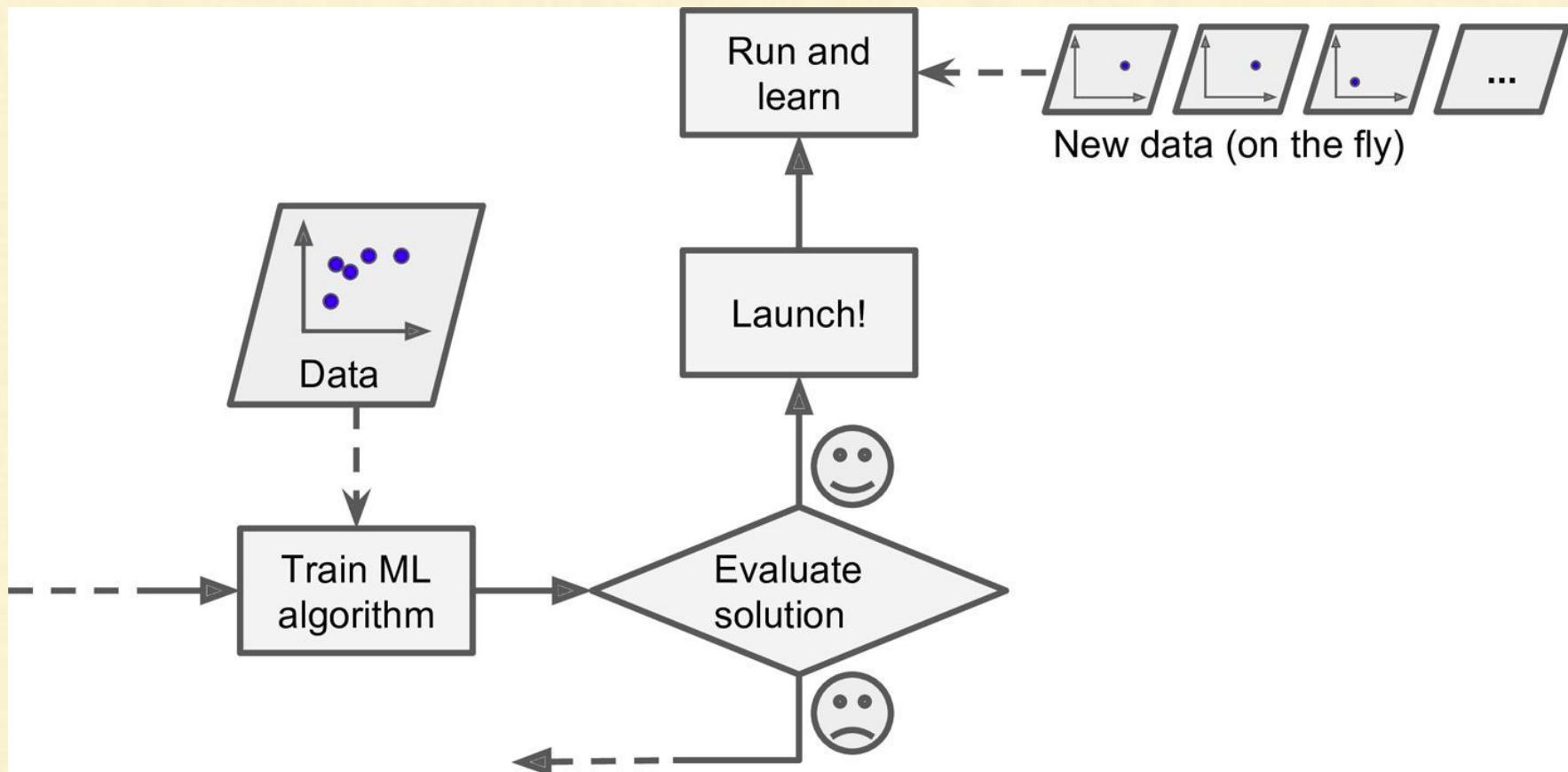
- We can not train the system incrementally
- We have to train the new system
 - From scratch on the full dataset
 - Stop the old system and
 - Replace it with the newly trained system

Machine Learning - Batch Learning

Limitations

- Since we have to train new system every time new data is available
 - Takes lot of computing resources
 - If the data is huge then
 - Training from scratch is nearly impossible
 - Becomes showstopper for lot of practical use cases

Machine Learning - Online Learning

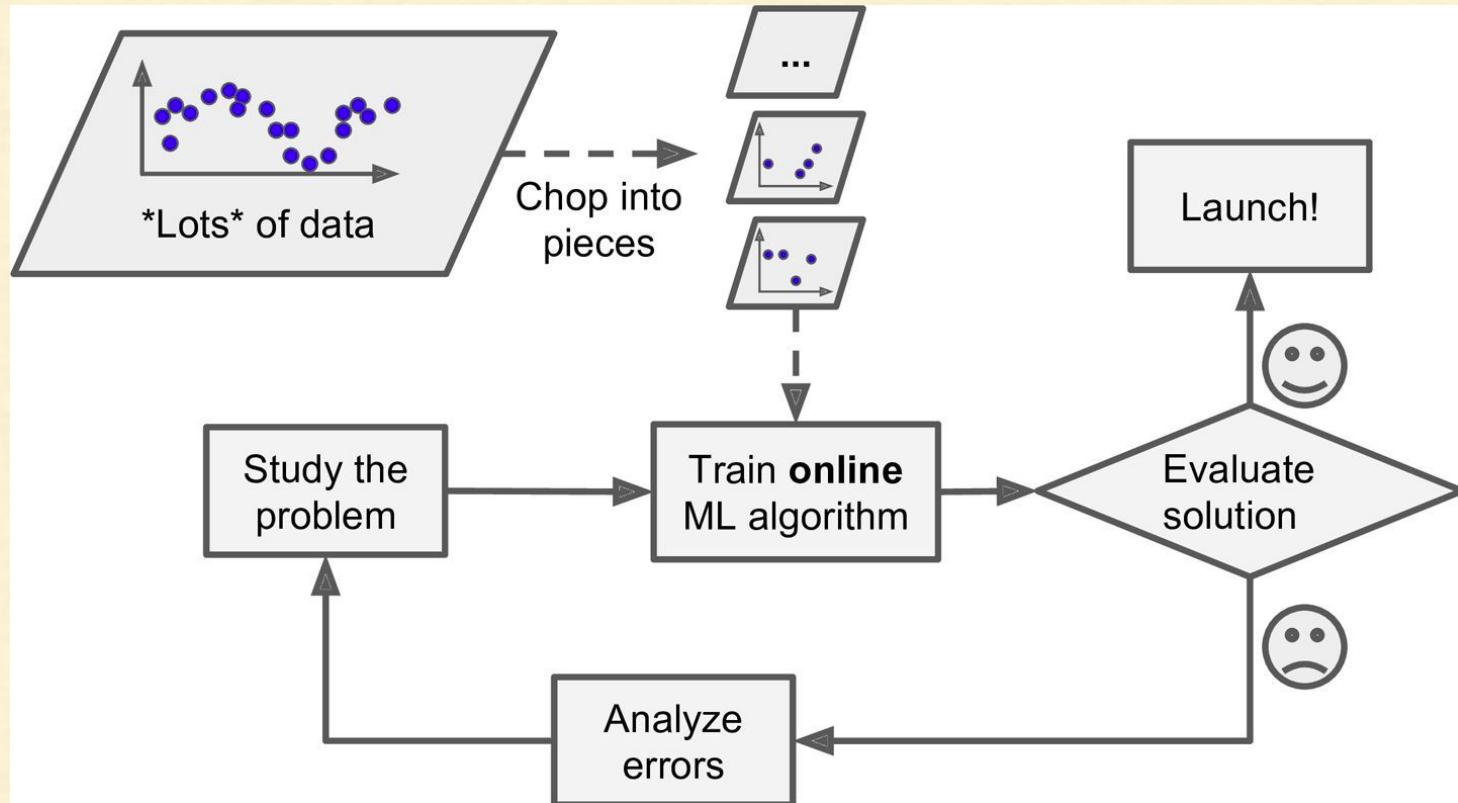


Machine Learning - Online Learning

- Train system incrementally
 - By feeding new data sequentially
 - Or in batches
- System can learn from new data on the fly
- Good for systems where data is a continuous flow
 - Stock prices

Machine Learning - Online Learning

Using online learning to handle huge datasets



Machine Learning - Online Learning

Using online learning to handle huge datasets

- Can be used to train huge datasets
 - That can not be fit in one machine
 - The training data gets divided into batches and
 - System gets trained on each batch incrementally

Machine Learning - Online Learning

Challenges in online learning

- System's performance gradually declines
 - If bad data is fed to the system
 - Bad data can come from
 - Malfunctioning sensor or robot
 - Someone spamming your system

Machine Learning - Online Learning

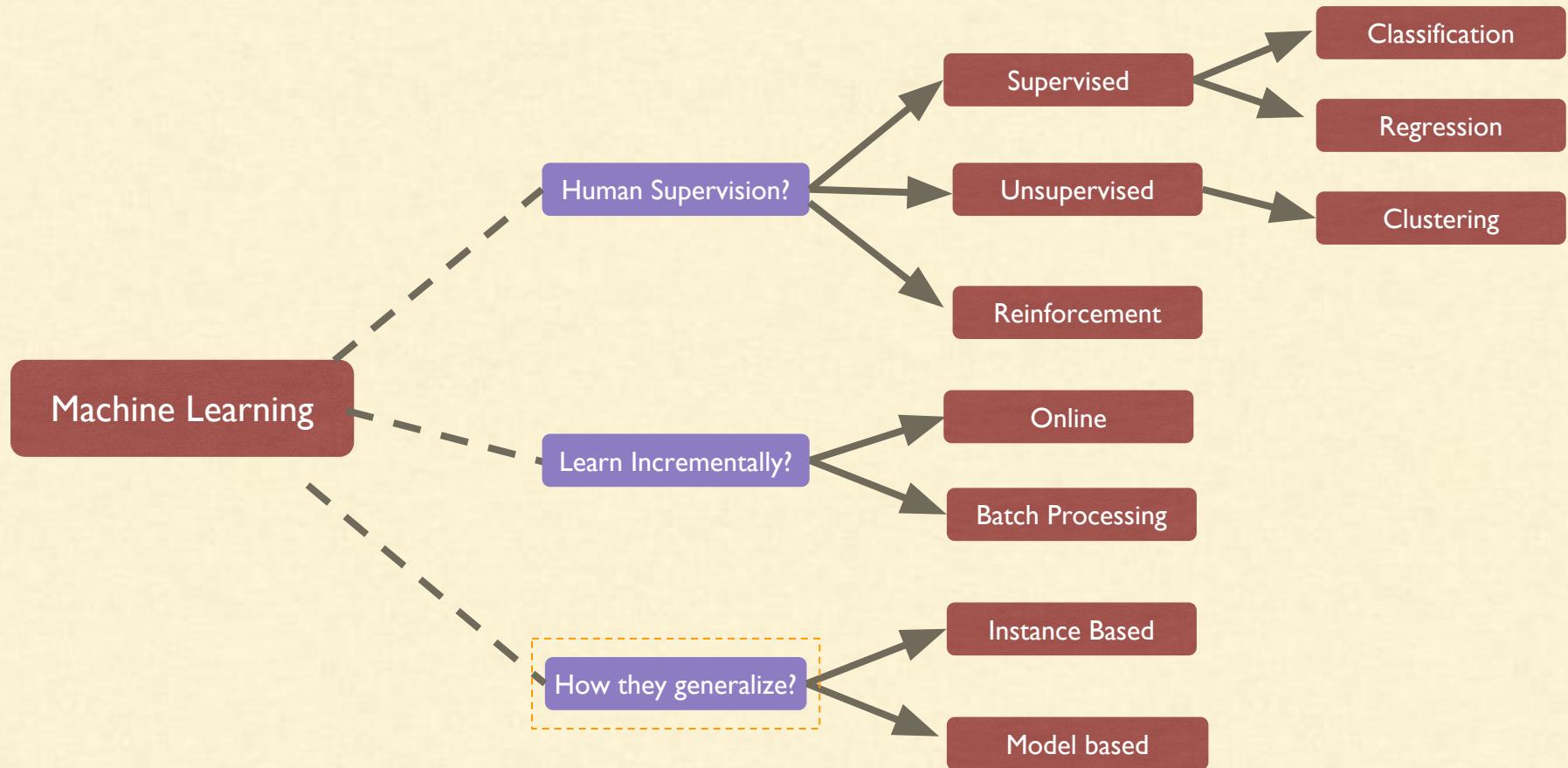
Challenges in online learning

- Closely monitor the system
 - Turn off the learning if there is a performance drop
 - Or monitor the input data and remove anomalies

Machine Learning - Instance & Model-Based Learning

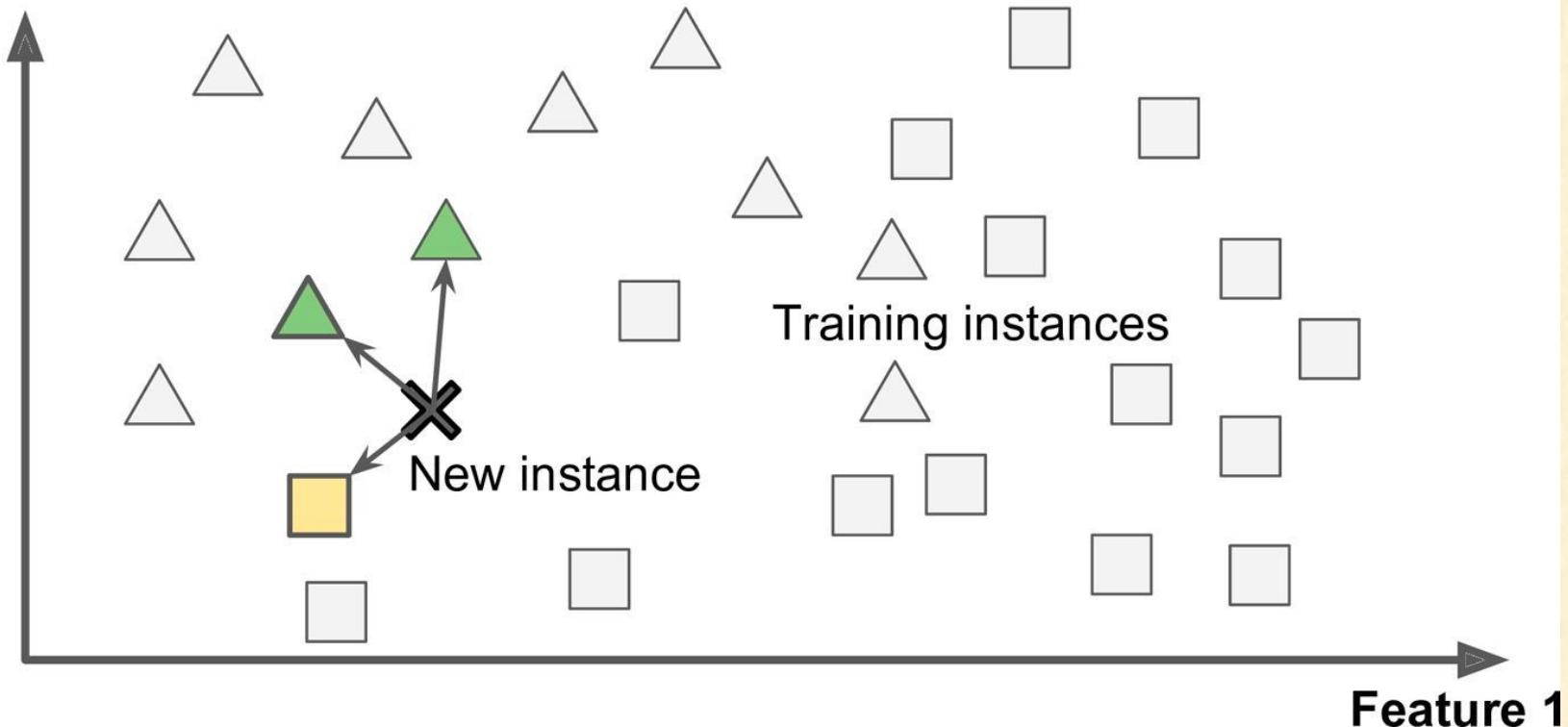
- Most Machine Learning tasks are about making predictions
- Having a good performance in training data is good
 - But true goal is to perform well on new instances
 - System needs to be able to generalize to examples it has never seen before

Machine Learning - Types



Machine Learning - Instance-based Learning

Feature 2



Machine Learning - Instance-Based Learning

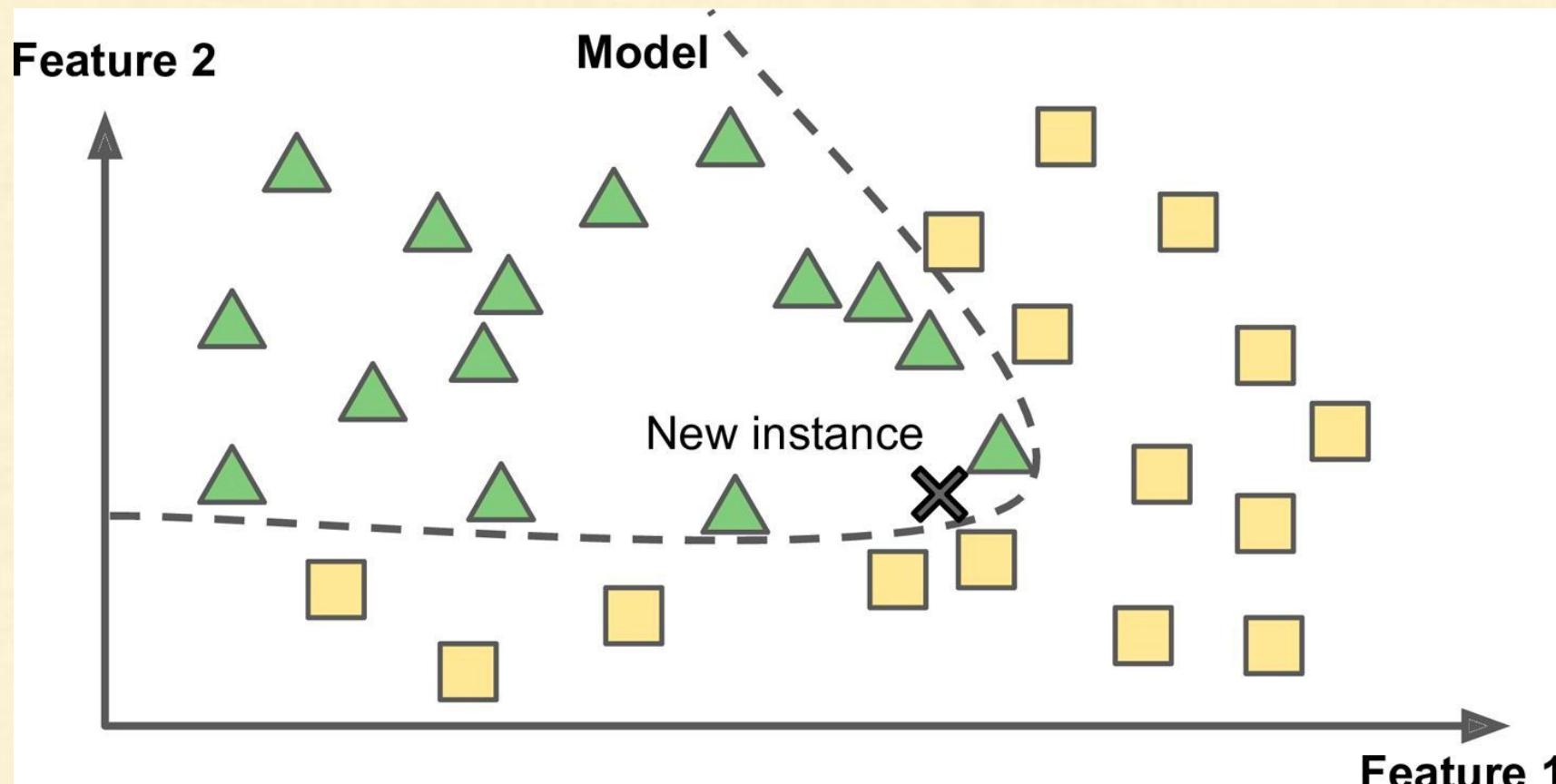
- Most trivial form of learning is
 - Learn by heart
- The system learns the examples by heart
- Then generalizes to new cases using a similarity measure

Machine Learning - Instance-Based Learning

Example

- Spam filter flags emails
 - That are identical to **known spam emails** (emails marked spam by users)
 - Also the emails which are similar to **known spam emails**
 - This requires **measure of similarity** between two emails
 - A basic **similarity measures** between two emails can be
 - Count the number of words they have in common

Machine Learning - Model-based Learning



Machine Learning - Model-Based Learning

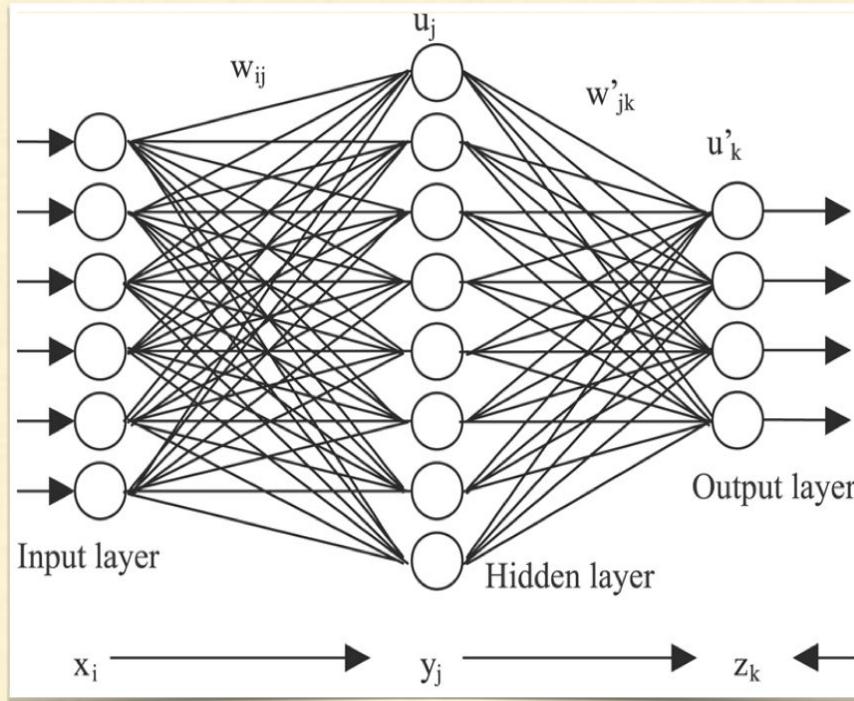
- Another way to generalize from a set of examples
 - Build a model of these examples
 - And then use model to make predictions
 - This is called **inference**
 - Hope that model will generalize well
 - We will learn more about it in next session

Machine Learning - Artificial Neural Network(ANN)



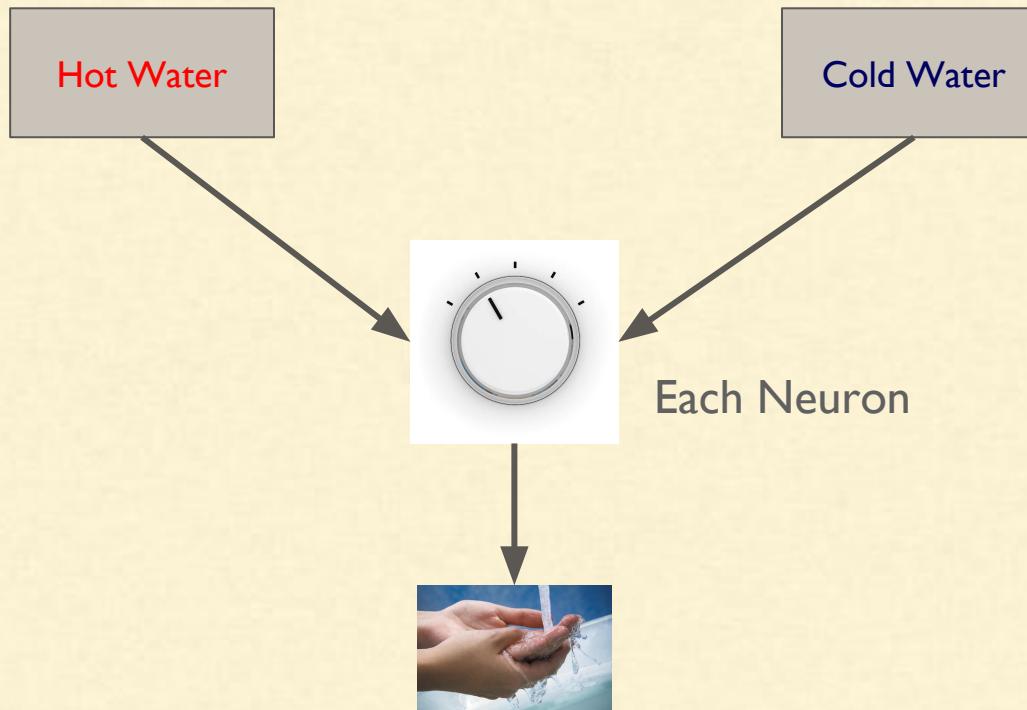
Computing systems inspired by the biological neural networks that constitute animal brains.

Machine Learning - Artificial Neural Network(ANN)



- Learn (progressively improve performance)
- To do tasks by considering examples
- Generally without task-specific programming
- Example: Based on image - cat or no cat?

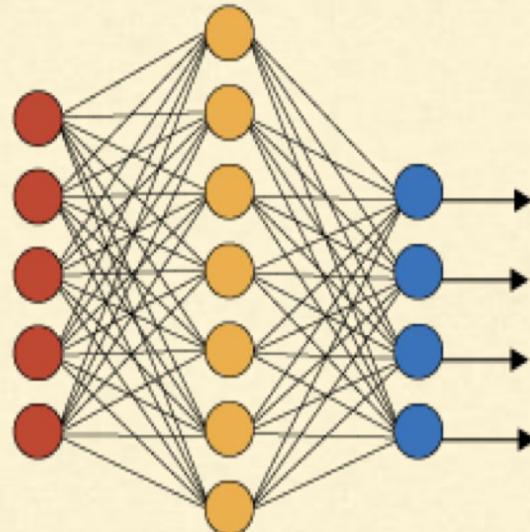
Machine Learning - Deep Learning



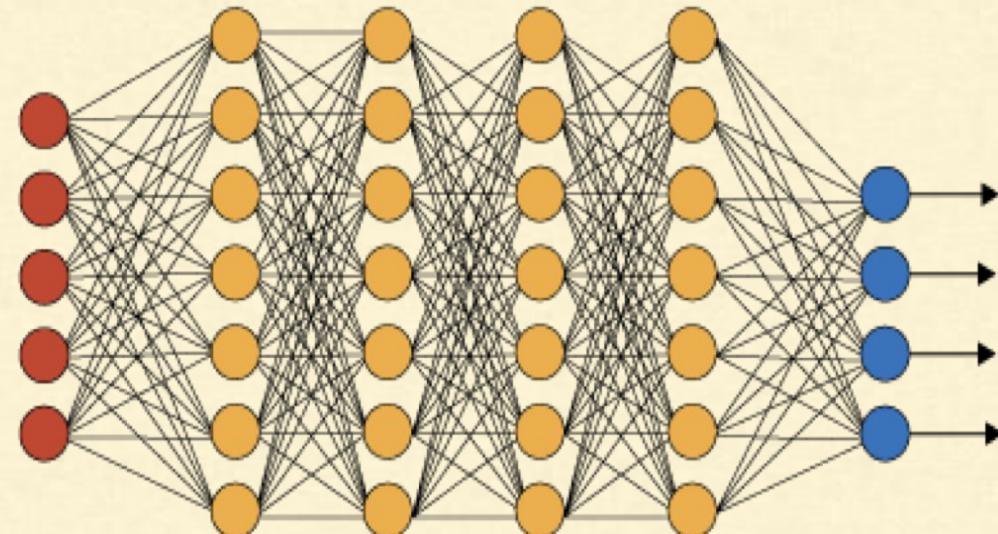
Each Neuron is like the knob.

Machine Learning - Deep Learning

Simple Neural Network



Deep Learning Neural Network



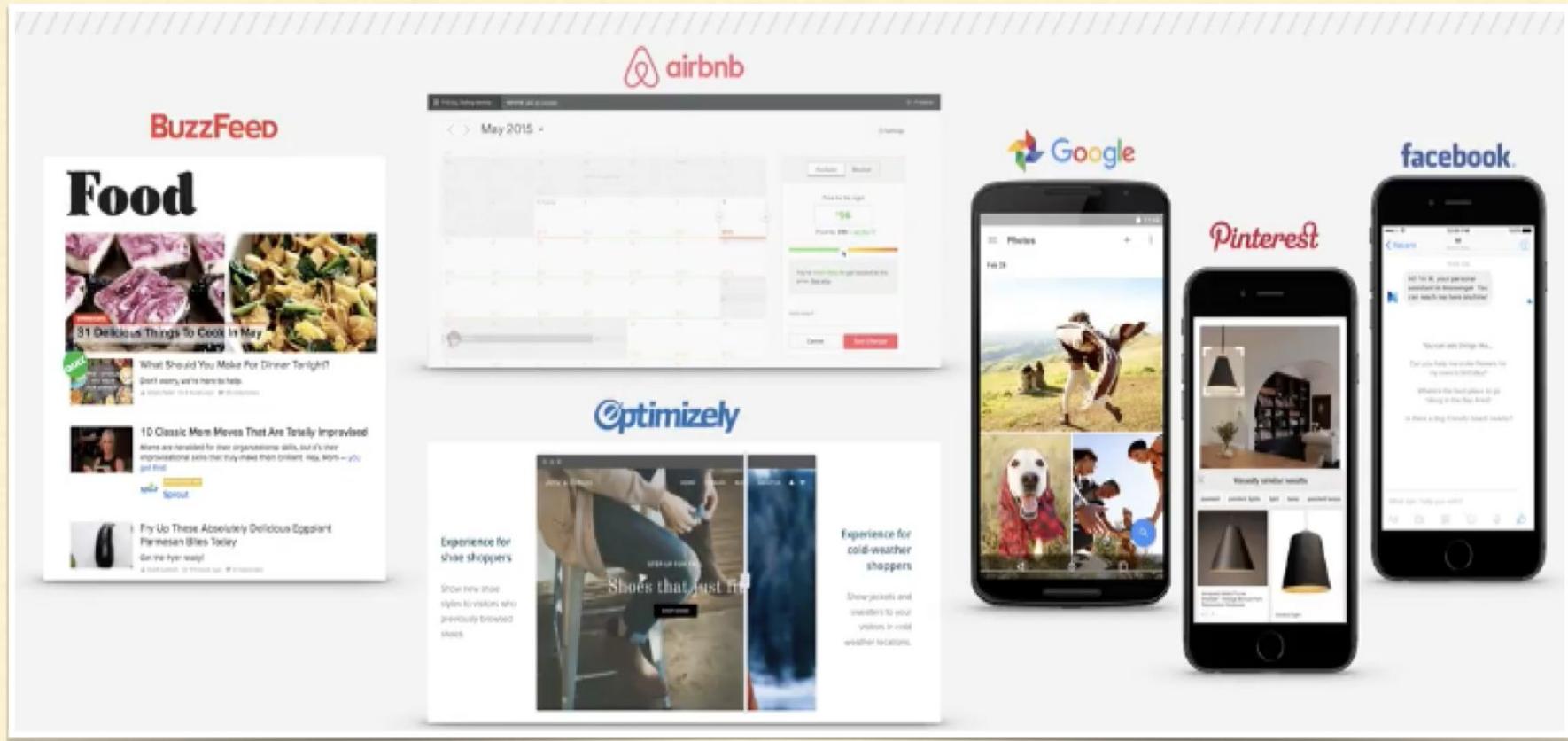
● Input Layer

● Hidden Layer

● Output Layer

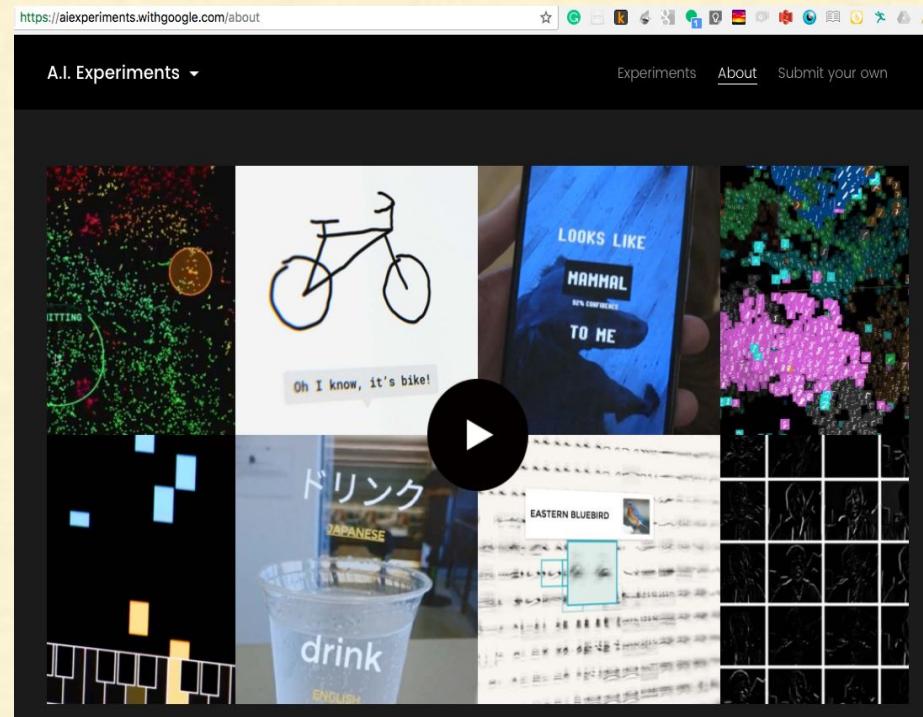
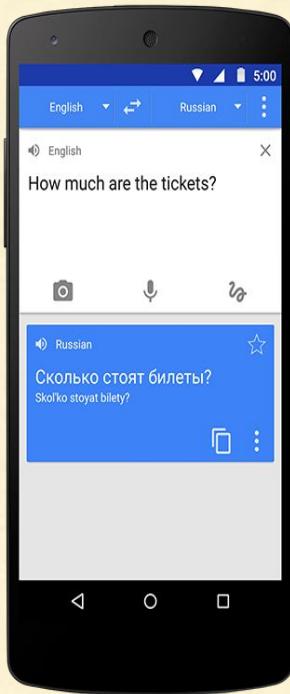
Multiple layers of neurons

Machine Learning - Who is Using?



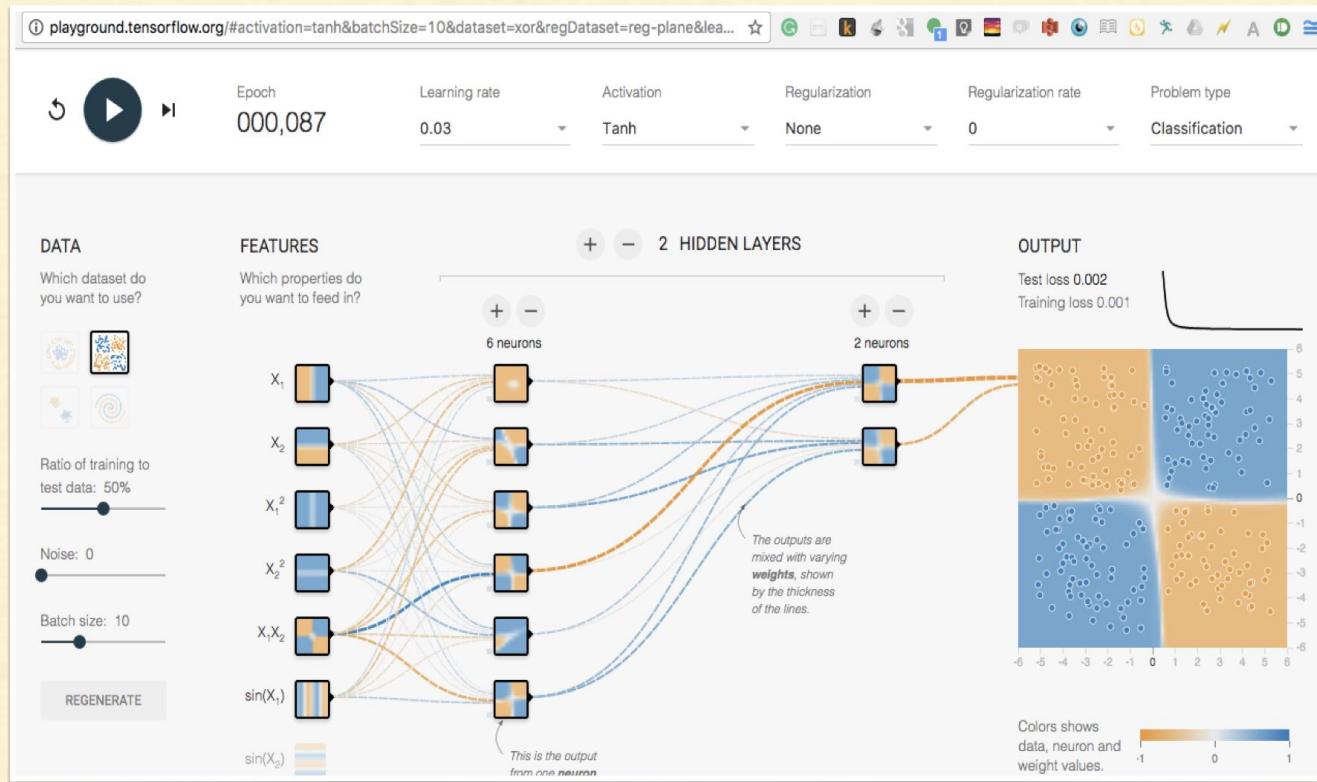
Almost Everyone

Google Translate & Auto Draw



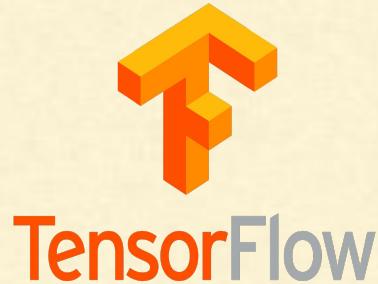
More use cases: <https://aiexperiments.withgoogle.com/>

TensorFlow - Demo



<http://playground.tensorflow.org/>

Deep Learning Frameworks



theano  Keras

Caffe



Machine Learning Frameworks

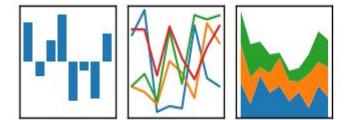


MLlib - Distributed



pandas

$$y_{it} = \beta' x_{it} + \mu_i + \epsilon_{it}$$



Simple

Learn More?

Machine Learning Courses



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Questions?

<https://discuss.cloudxlab.com>

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