ARTIFICIAL INTELLIGENCE WORKSHOP

MUSTAFA ALDEMIR, INTEL TURKEY

Registration: http://bit.ly/kings-intel
Codes & Slides: http://bit.ly/ai-workshop

MUSTAFA ALDEMIR

AI & IoT

Software Engineer
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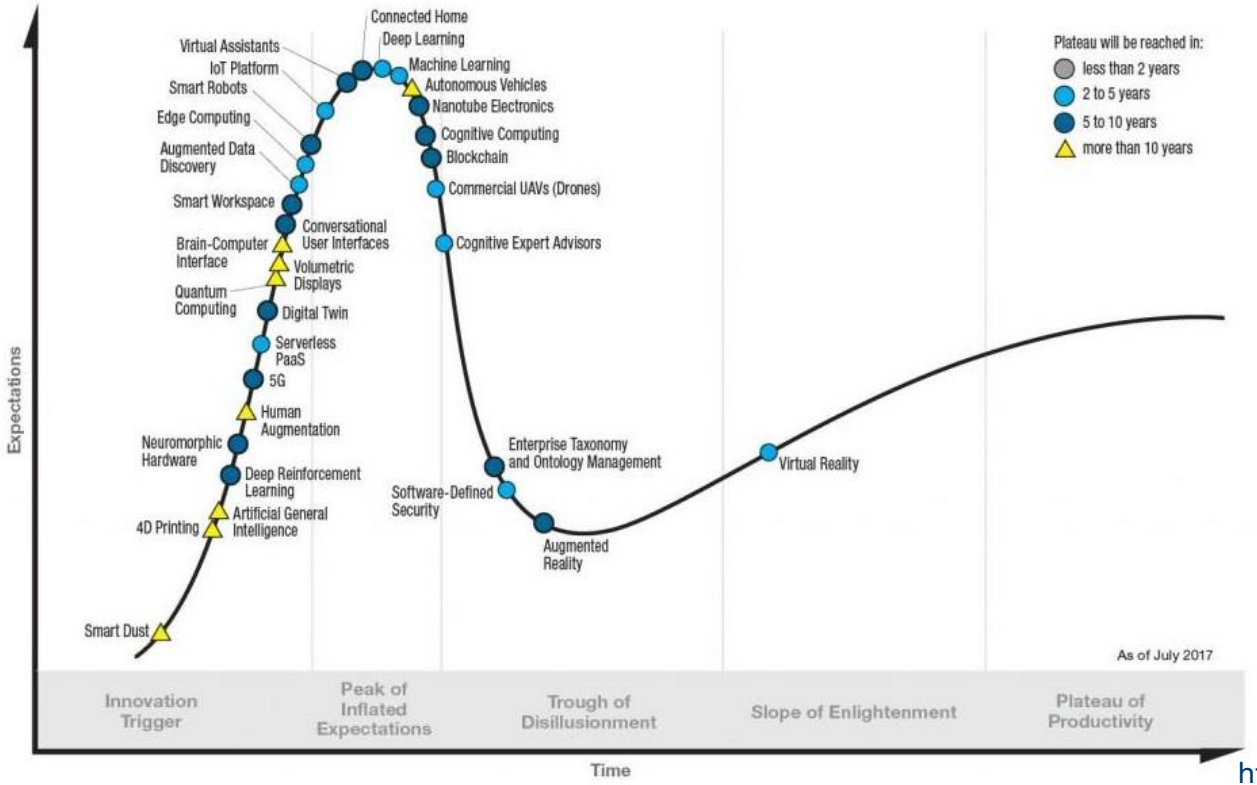
http://bit.ly/mstfldmr

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

GARTNER'S HYPE CYCLE FOR EMERGING TECHNOLOGIES, 2017



http://www.gartner.com

OUTLINE

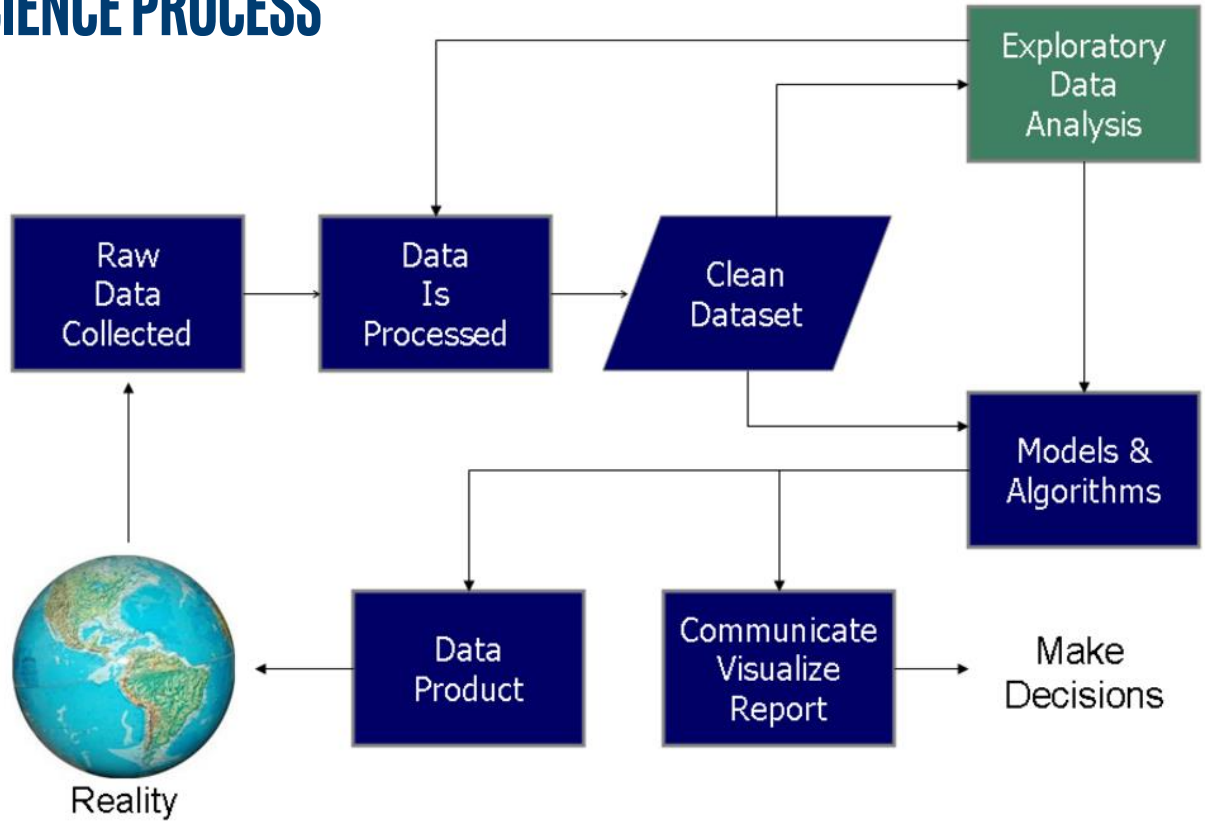
- Introduction to Data Science
- Introduction to Machine Learning
  - Supervised Learning
  - Unsupervised Learning
  - Reinforcement Learning

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

DATA SCIENCE

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

THE DATA SCIENCE PROCESS



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

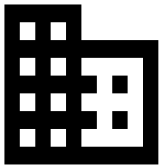
DAILY DATA GENERATION IN 2020

1.5GB

3,000GB

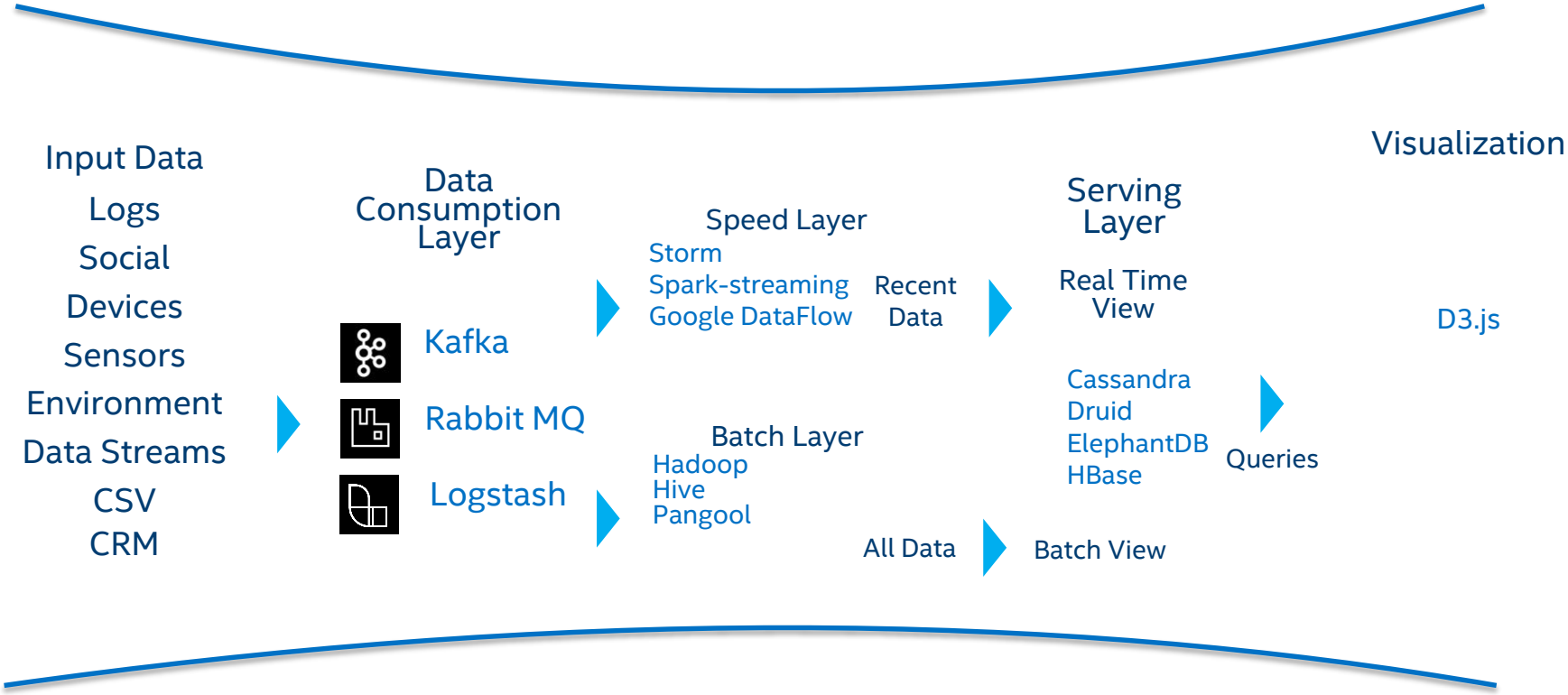
4,000GB

40,000GB



1,000,000GB

DATA SCIENCE - INGESTION TO VISUALIZATION



WHAT IS ARTIFICIAL INTELLIGENCE

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



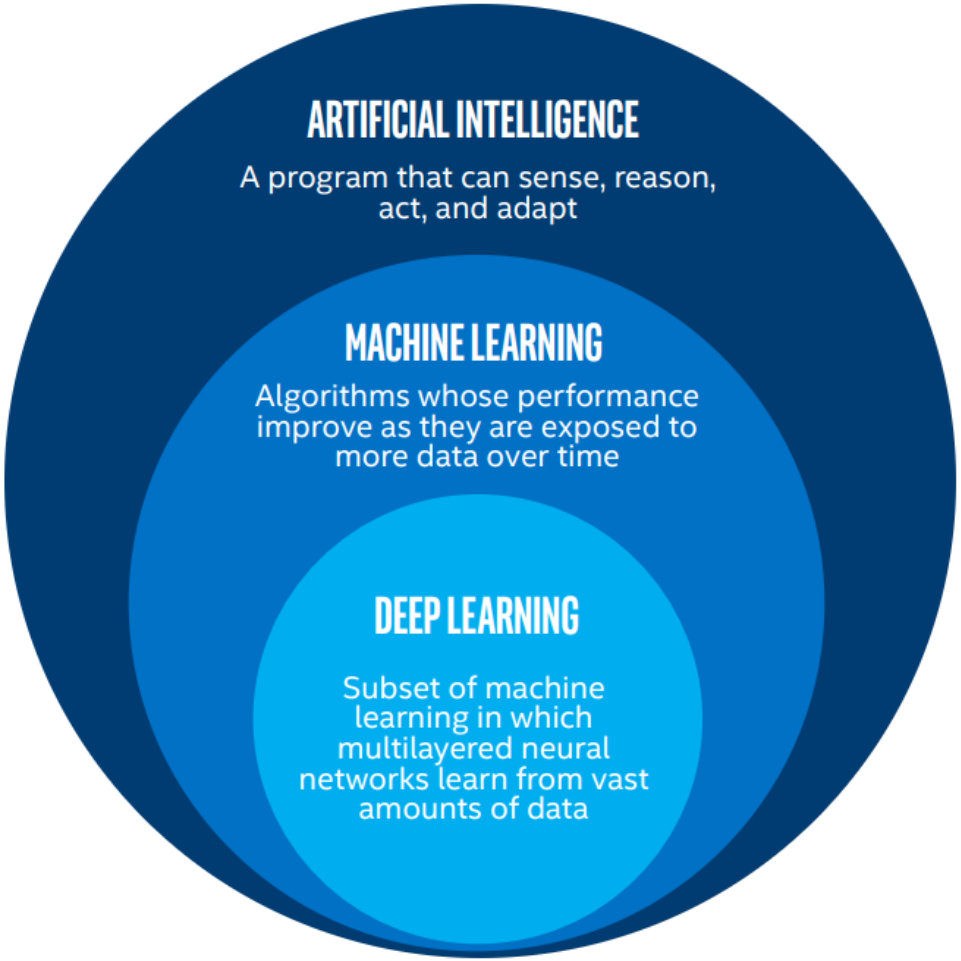





	CONSUMER	HEALTH	FINANCE	RETAIL	GOVERNMENT	ENERGY	TRANSPORT	INDUSTRIAL	OTHER
EXAMPLES	Smart Assistants Chat bots Search Personalization Augmented Reality Robots	Enhanced Diagnostics Drug Discovery Patient Care Research Sensory Aids	Algorithmic Trading Fraud Detection Research Personal Finance Risk Mitigation	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


ARTIFICIAL INTELLIGENCE
A program that can sense, reason, act, and adapt
MACHINE LEARNING
Algorithms whose performance improve as they are exposed to more data over time
DEEP LEARNING
Subset of machine learning in which multilayered neural networks learn from vast amounts of data

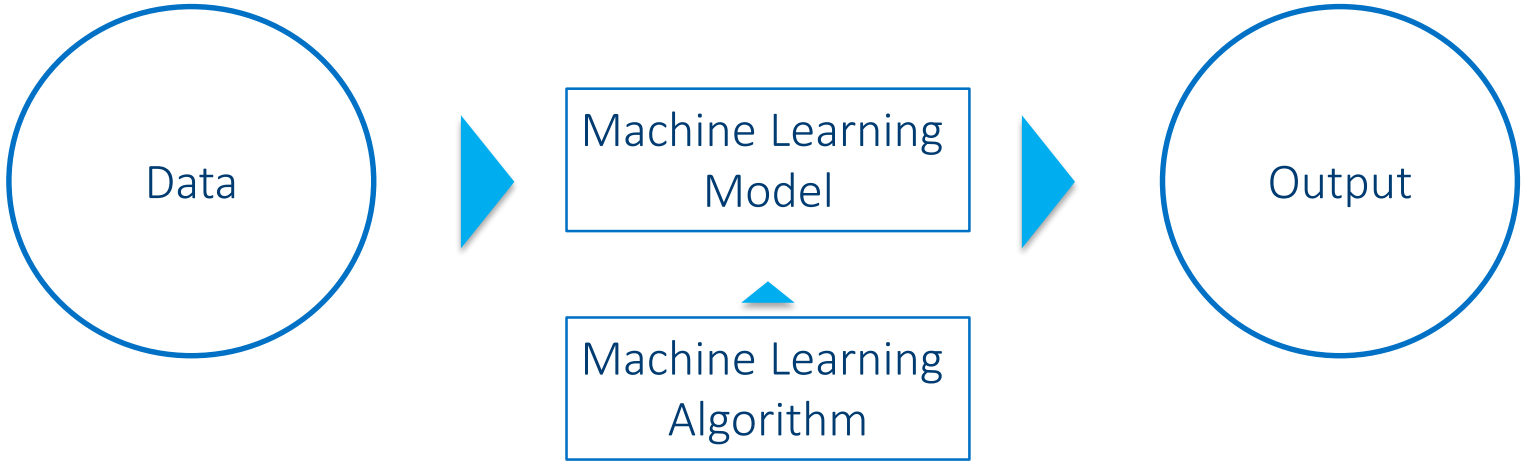
WHAT IS
MACHINE LEARNING

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 London this year, we take 75-80% of the data (randomly!!!) to train the model.

TEST DATA SET

Remaining 20-25% of the data- we hide it from the model, **Test Dataset**.
That will help us understand how well the model will perform for new data.

FRAMEWORKS & LANGUAGES

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

TYPES OF MACHINE LEARNING

Types of Machine Learning

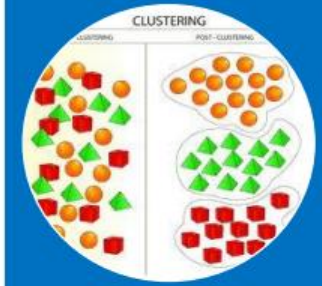
Supervised Learning

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”.

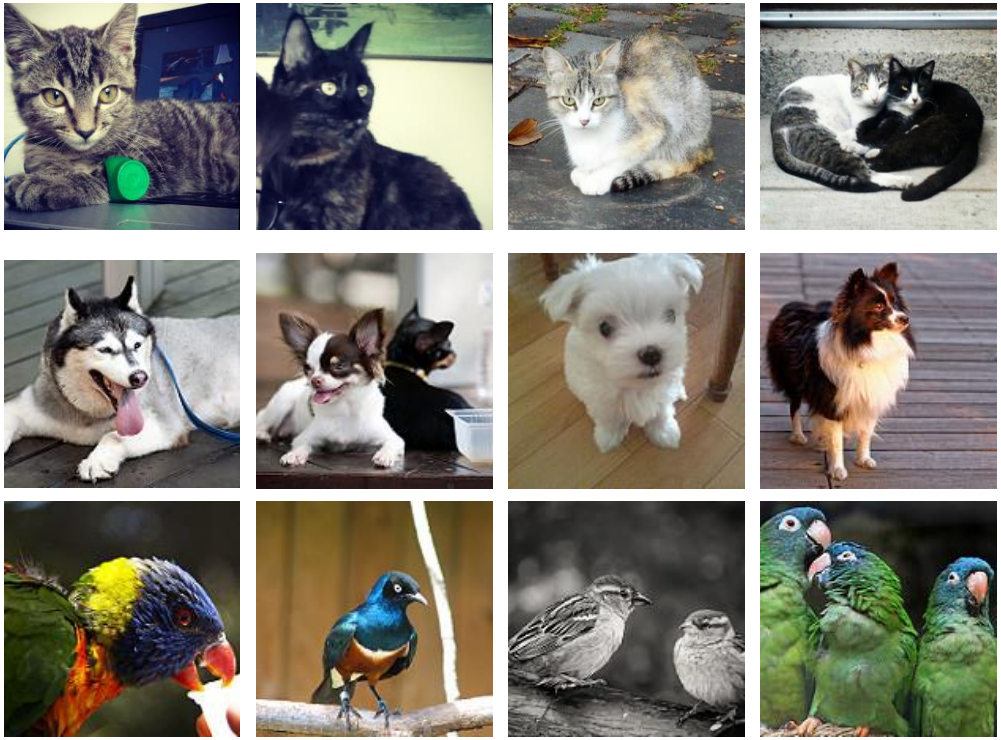
MACHINE LEARNING SOLUTIONS

CLASSIFICATION

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

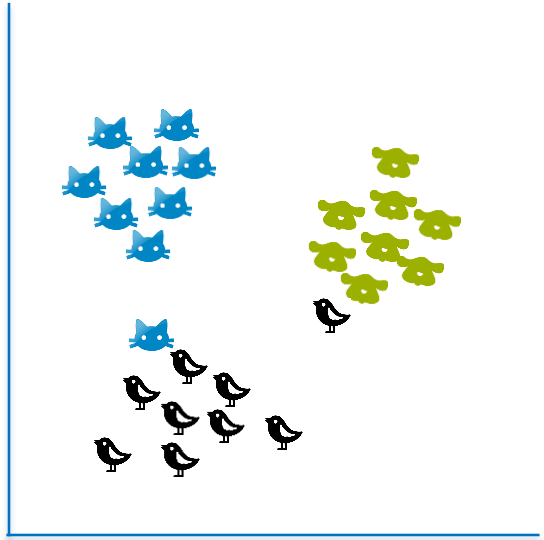
REGRESSION

CLASSIFICATION

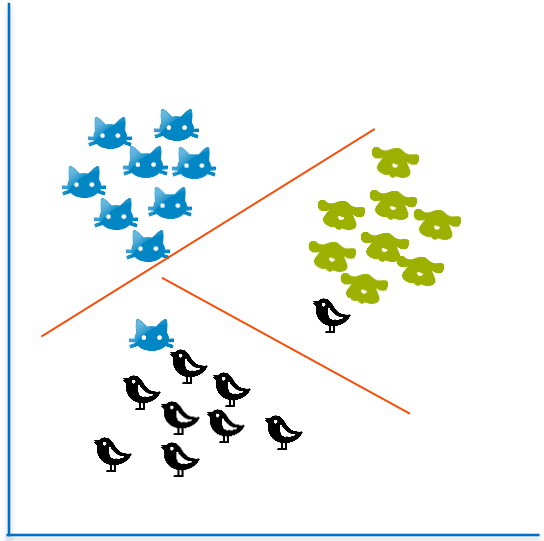


?

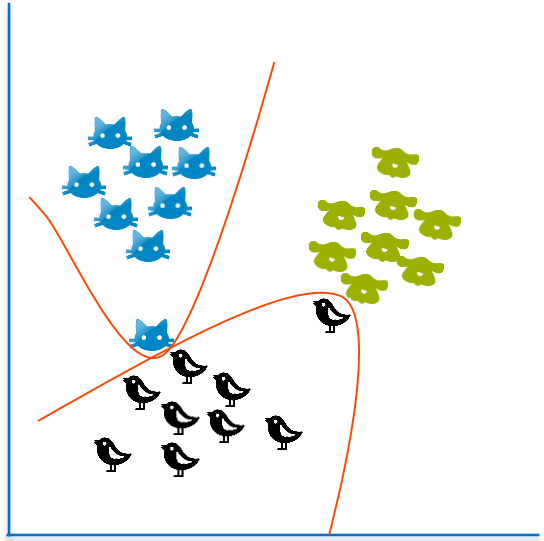
CLASSIFICATION



CLASSIFICATION



CLASSIFICATION



HANDS-ON WORK

Installing Anaconda, Scikit-Learn, Tensorflow & Jupyter

Installing Anaconda

Download Anaconda Python 3.6 version from
https://www.continuum.io/downloads

Run the installer it:

Windows & Mac OS: double click

Linux: cd Downloads
cmod u+x Anaconda3-5.0.0.1-Linux-x86_64.sh
./Anaconda3-5.0.0.1-Linux-x86_64.sh

Install Required Packages


```
conda update conda
conda config --add channels intel
conda create -n workshop intelpython3_core python=3.6
```

```
activate workshop (Windows)
source activate workshop (Linux & Mac)
```

```
conda install numpy pandas scikit-learn tensorflow jupyter
pip install tflearn pillow --no-deps
```

Run Jupyter

jupyter notebook

Navigate to
http://localhost:8888/

HANDS-ON WORK

Case Study: Iris Dataset

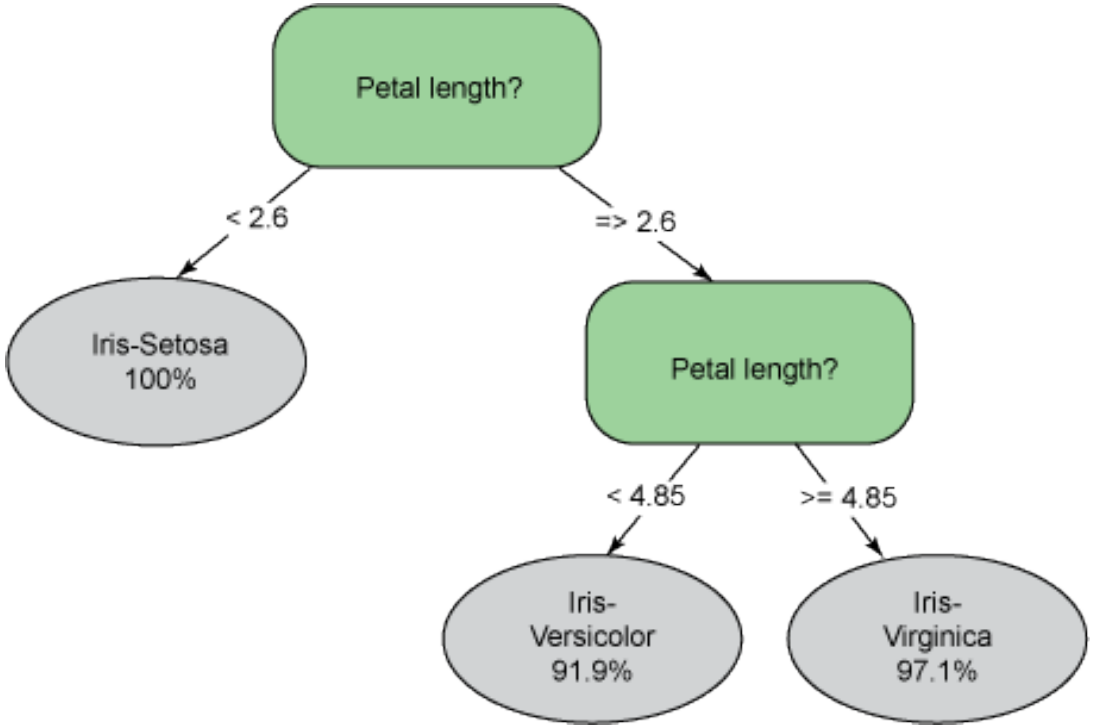
CASE STUDY: IRIS PLANTS

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.

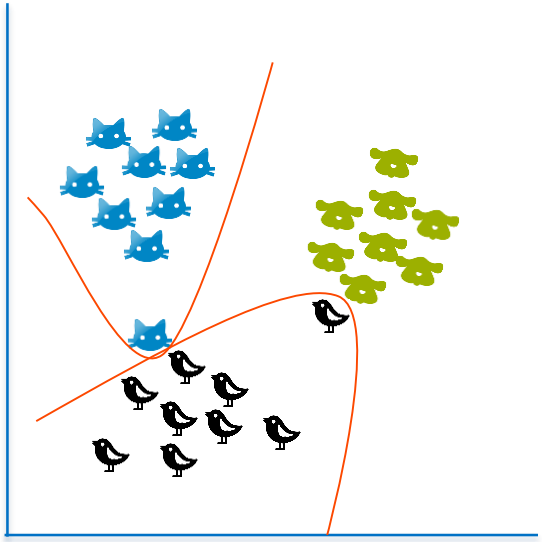
Number of Attributes: 4 (sepal length in cm, sepal width in cm, petal length in cm, petal width in cm)
Number of Instances: 150 (50 in each of three classes)
Target: Iris-Setosa, Iris-Versicolour, Iris-Virginica

DECISION TREES

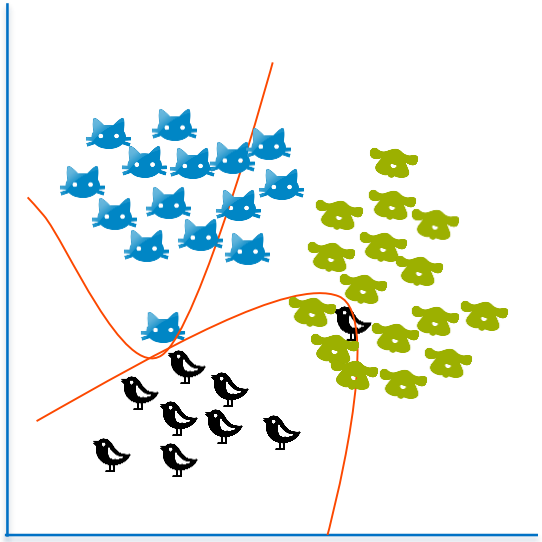


OVERFITTING

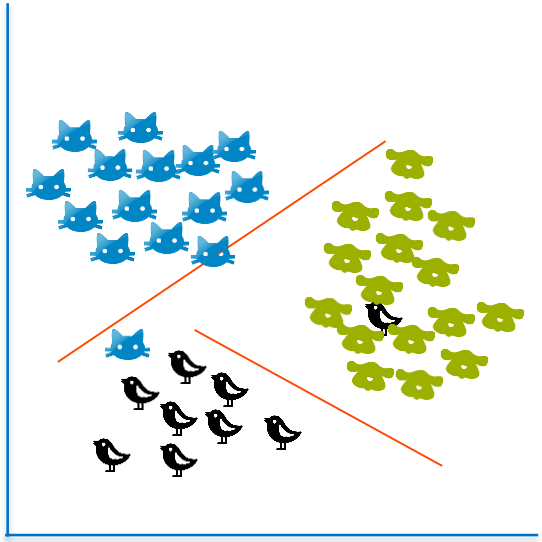
TRAINNING



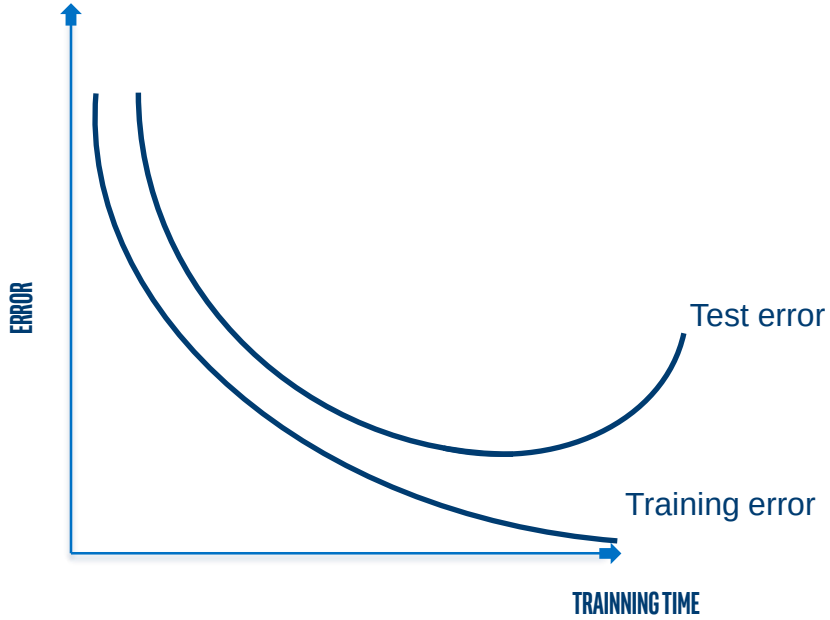
TESTING



TESTING



OVERFITTING

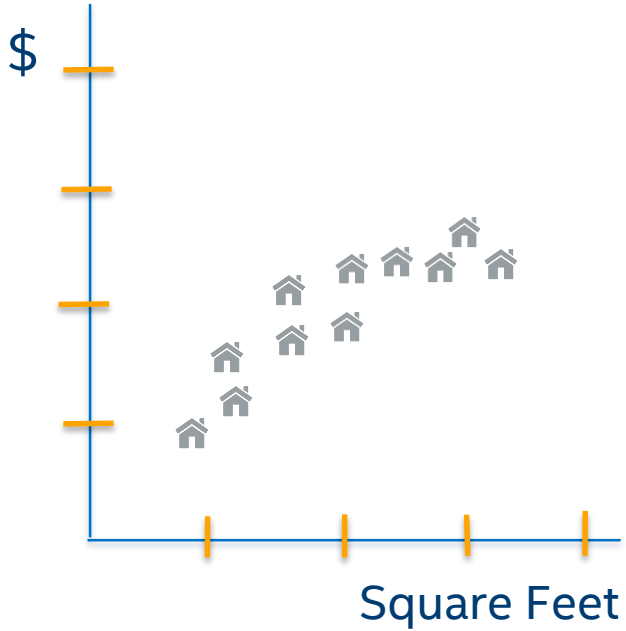


SUPERVISED LEARNING

CLASSIFICATION

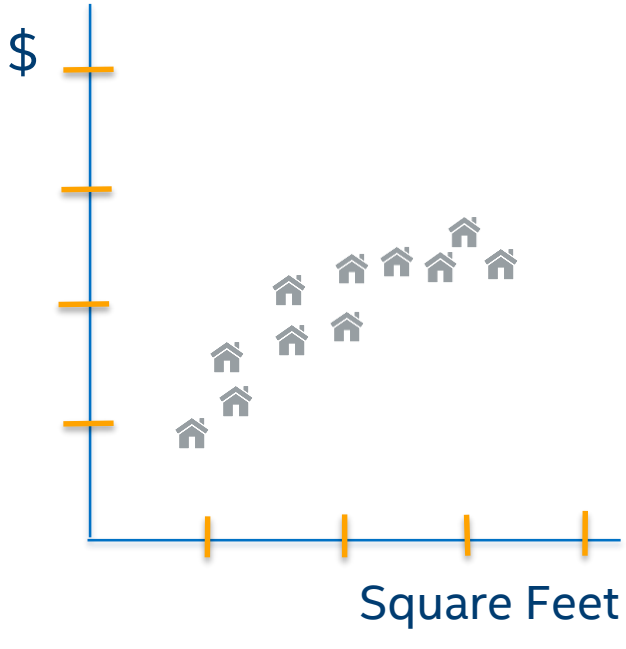
REGRESSION

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

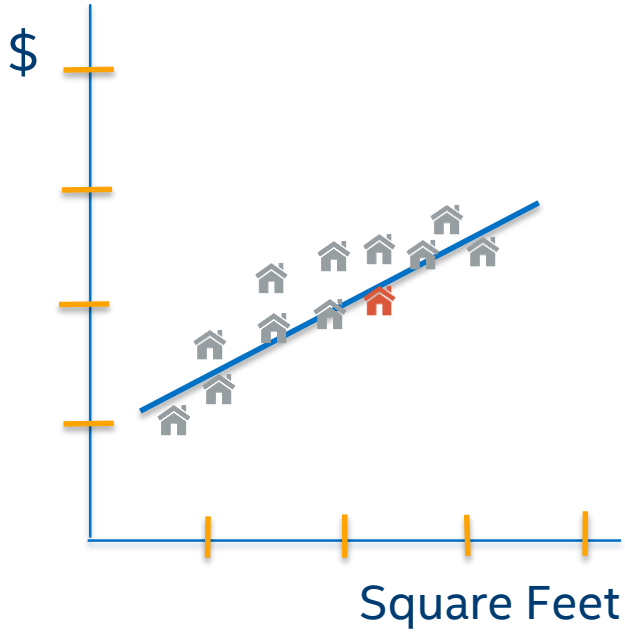


Set of Input vectors having a class or label

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.



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.

HANDS-ON WORK

Case Study: Regression with CO2 Emission and Global Warming Datasets

CASE STUDY: CO2 EMISSION AND GLOBAL WARMING

Carbon Dioxide Emission Dataset:

Number of Attributes: 1
Number of Instances: 260
Target: Column Total is the amount of emission from year 1751 to 2010

Global Warming Dataset:

Number of Attributes: 1
Number of Instances: 272 (recordings from 2 sources are listed together)
Target: Column Mean is the increase of global temperature from year 1880 to 2010

CASE STUDY: CO2 EMISSION AND GLOBAL WARMING

Linear Regression with Multiple Features

iPython notebook:

https://github.com/mstfldmr/IntelAIWorkshop/blob/master/LinearRegression2.ipynb

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

UNSUPERVISED LEARNING

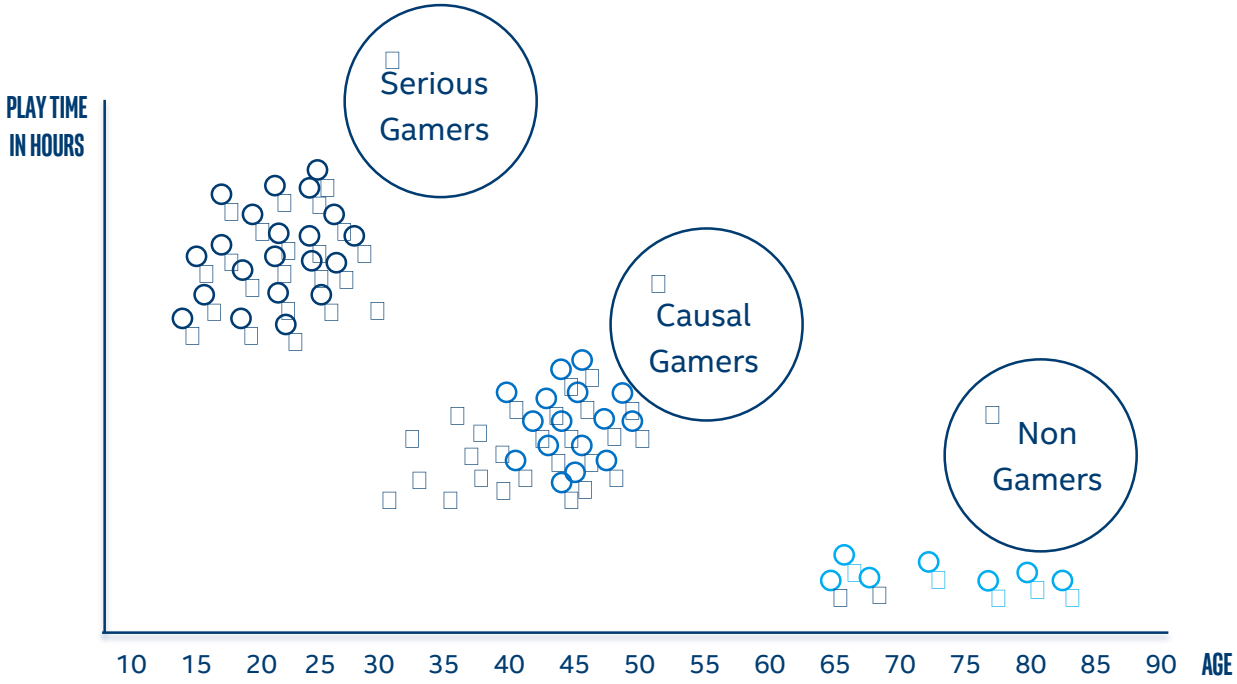
DATA IS GIVEN TO THE MODEL. RIGHT ANSWERS ARE NOT PROVIDED TO THE MODEL. THE MODEL MAKES SENSE OF THE DATA GIVEN TO IT.

UNSUPERVISED LEARNING

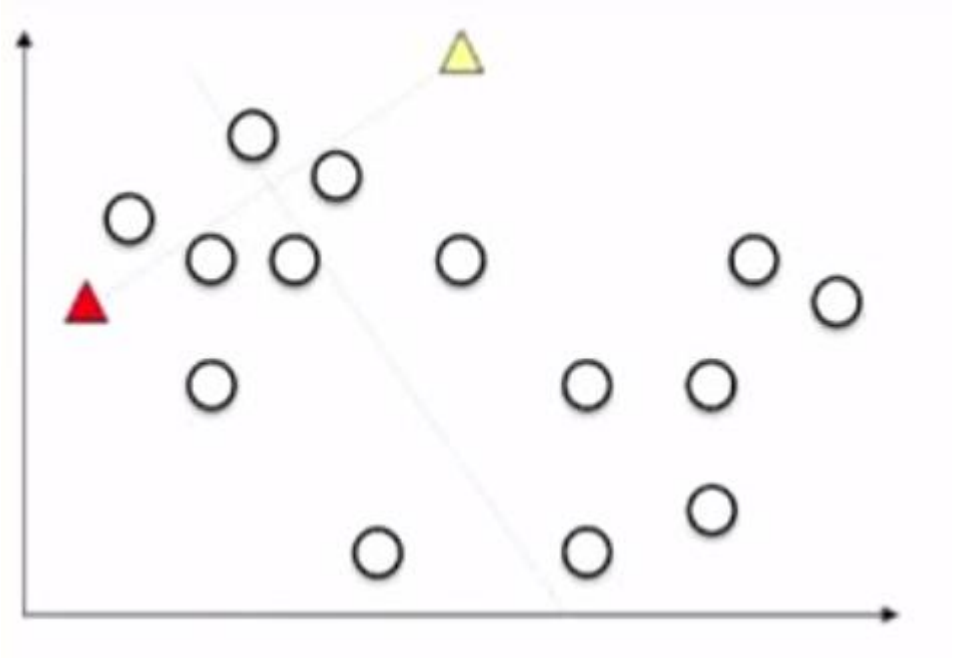
CLUSTERING

Grouping entities with similar features.
Unsupervised learning.

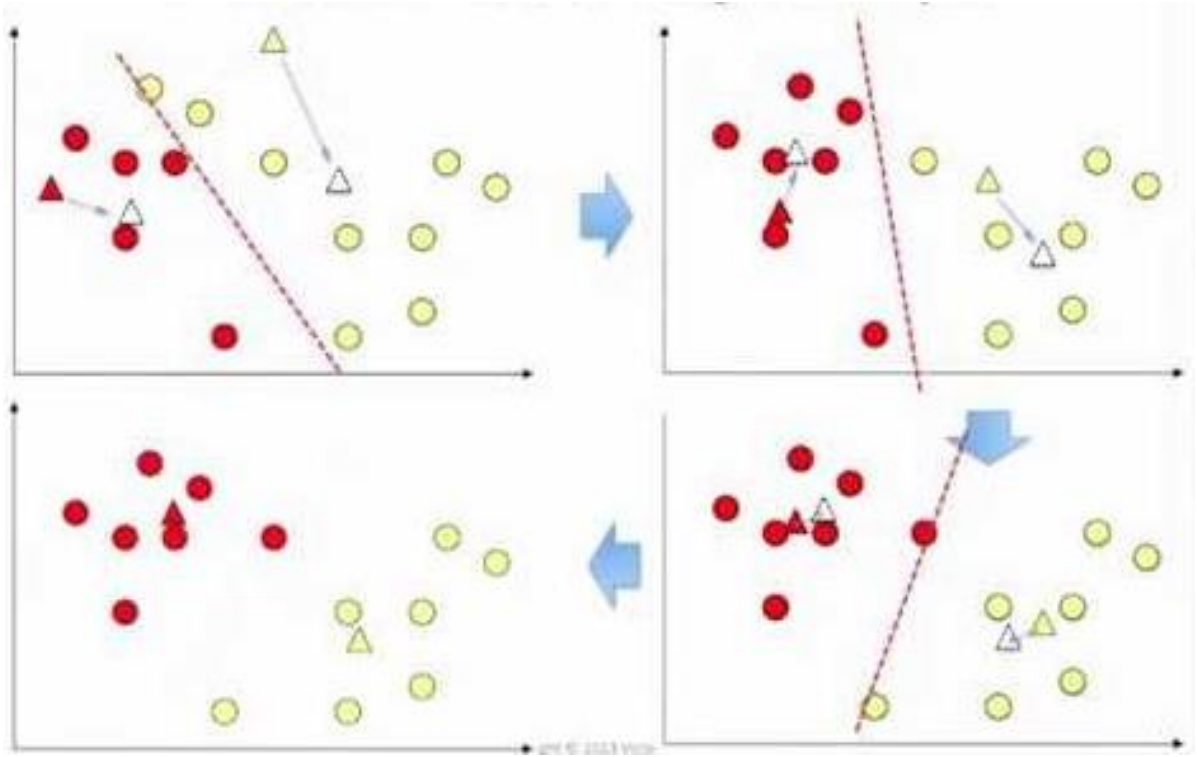
CLUSTERING EXAMPLE: MARKET SEGMENTATION



K-MEANS CLUSTERING



K-MEANS CLUSTERING



HANDS-ON WORK

Case Study: Iris Dataset

CASE STUDY: IRIS PLANTS

K-Means Clustering

iPython notebook:

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

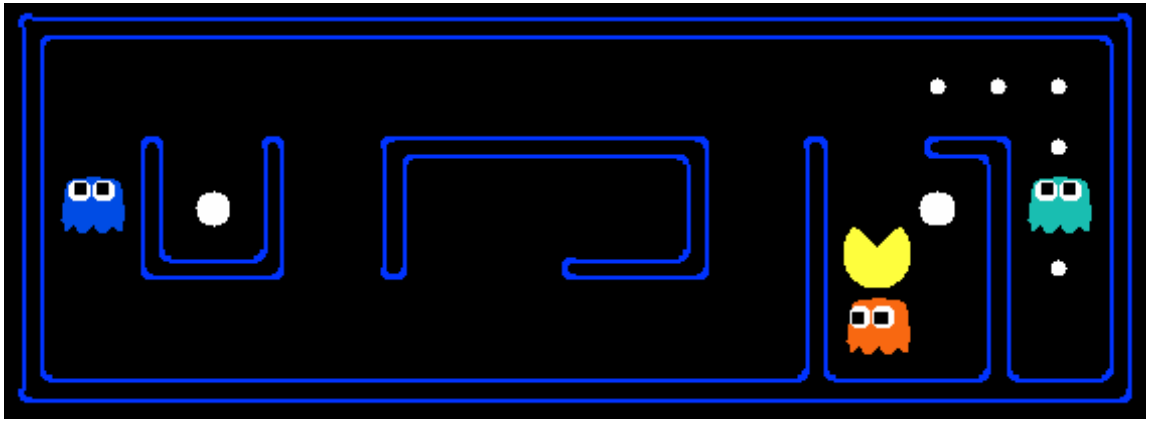
https://github.com/mstfldmr/IntelAIWorkshop/blob/master/KMeansClustering2.ipynb

REINFORCEMENT LEARNING

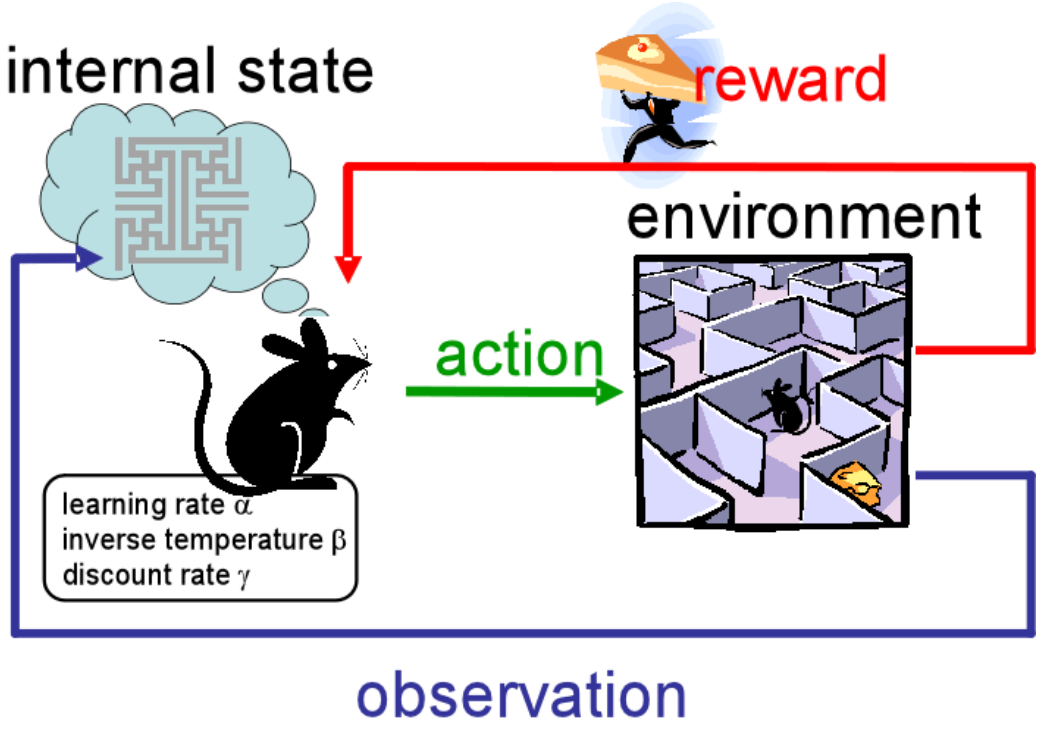
REINFORCEMENT LEARNING IS THE PROBLEM OF GETTING AN AGENT TO ACT IN THE WORLD SO AS TO MAXIMIZE ITS REWARDS.

REINFORCEMENT LEARNING

- Robotics
- Healthcare
- Smart cities



REINFORCEMENT LEARNING



DEEP LEARNING

DEEP LEARNING: EXAMPLES

Images
Computer vision, Image classification, Traffic sign detection, Pedestrian detection, localization…

Sound
Speech recognition, Natual Language Processing, Translation, Content captioning, speaker identification

"Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum."

Text
Natual Language Processing, text classification; web search, spam, email filtering

CLASSIFICATION

-> Label the image

Person

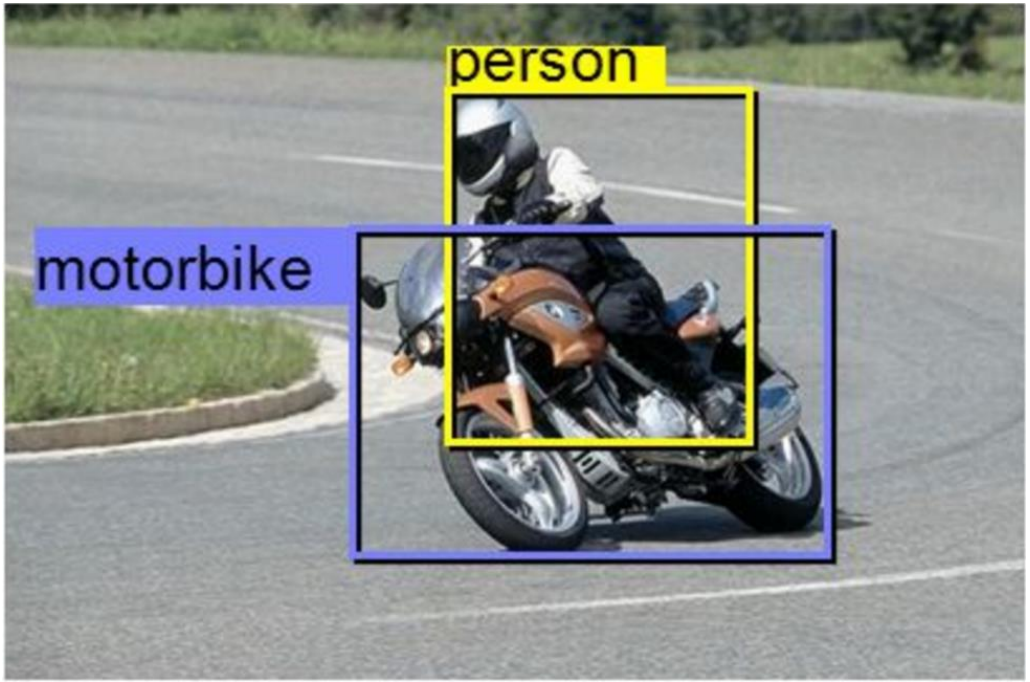
Motorcyclist

Bike

https://people.eecs.berkeley.edu/~jhoffman/talks/lsda-baylearn2014.pdf

DETECTION

-> Detect and label



https://people.eecs.berkeley.edu/~jhoffman/talks/lsda-baylearn2014.pdf

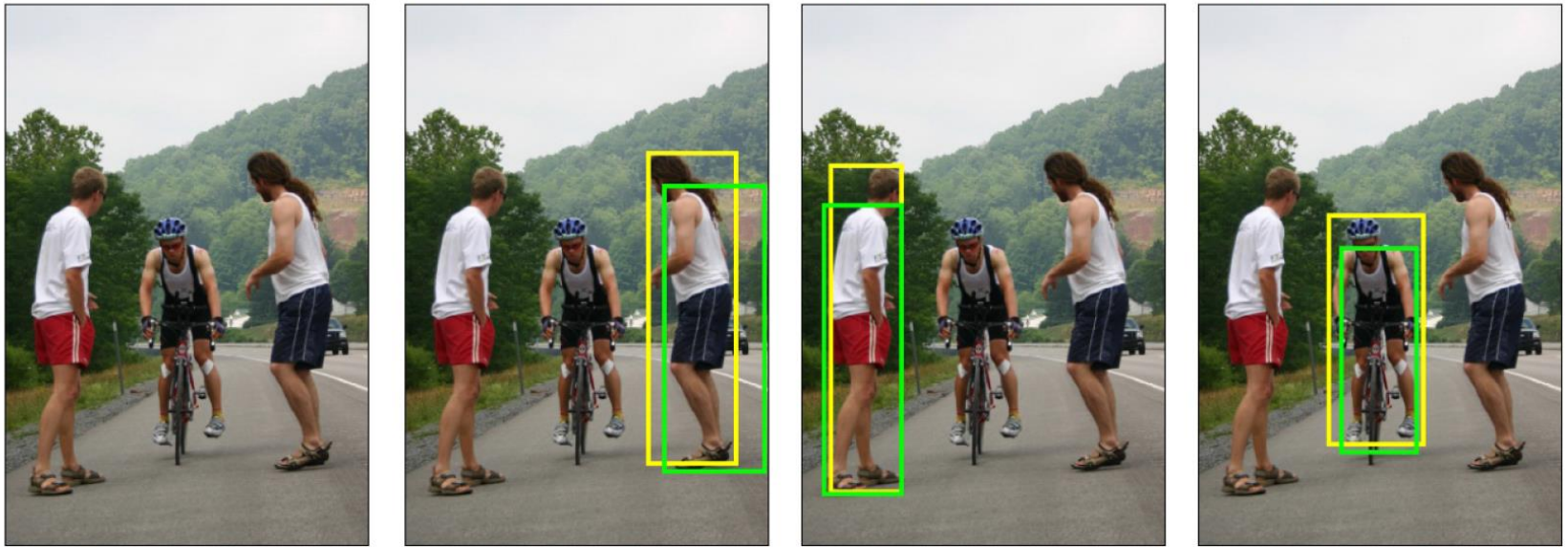
SEMANTIC SEGMENTATION

-> Label every pixel

https://people.eecs.berkeley.edu/~jhoffman/talks/lsda-baylearn2014.pdf

NATURAL LANGUAGE OBJECT RETRIEVAL

a scene with three people query='*man far right*' query='*left guy*' query='*cyclist*'



http://arxiv.org/pdf/1511.04164v3.pdf

SPEECH RECOGNITION

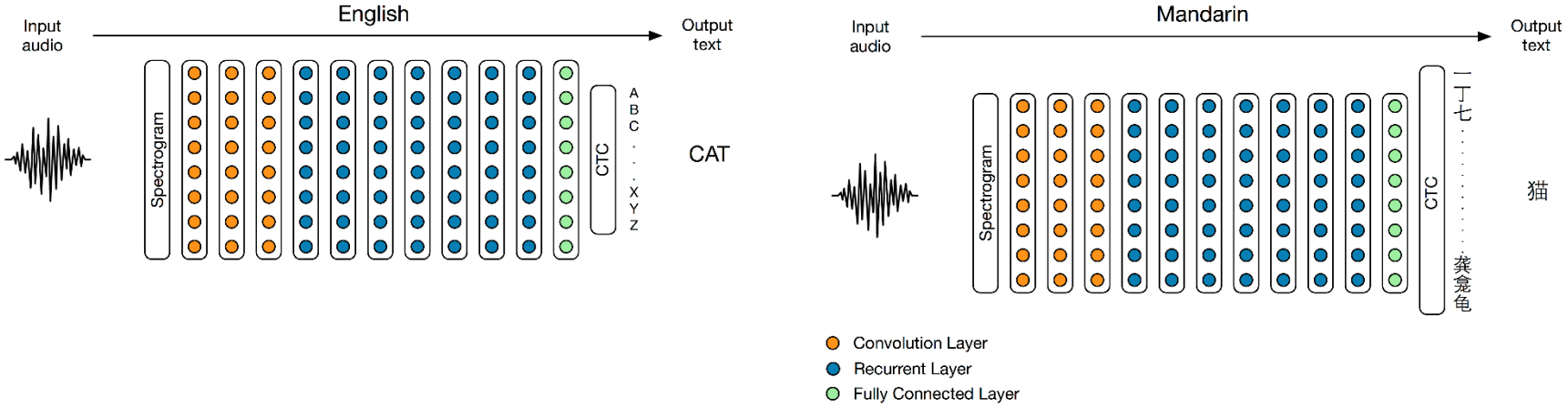
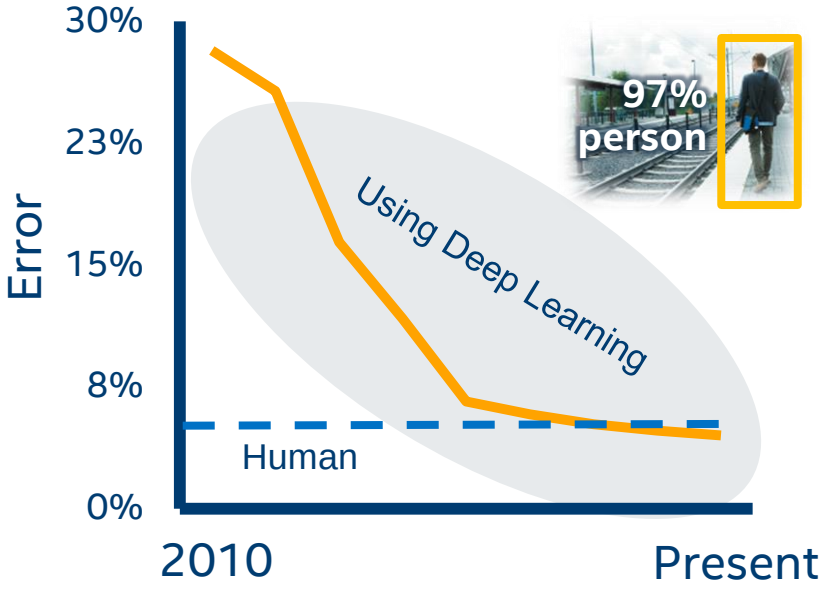


IMAGE / VIDEO CAPTIONING

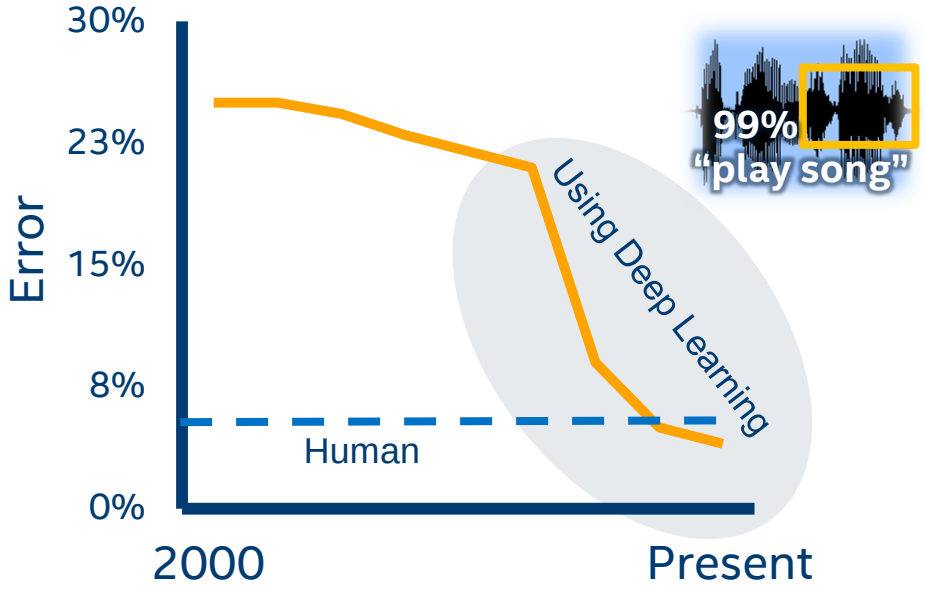
Describes without errors	Describes with minor errors	Somewhat related to the image
		
A person riding a motorcycle on a dirt road.	Two dogs play in the grass.	A skateboarder does a trick on a ramp.
		
A group of young people playing a game of frisbee.	Two hockey players are fighting over the puck.	A little girl in a pink hat is blowing bubbles.

DEEP LEARNING BREAKTHROUGHS

IMAGE RECOGNITION



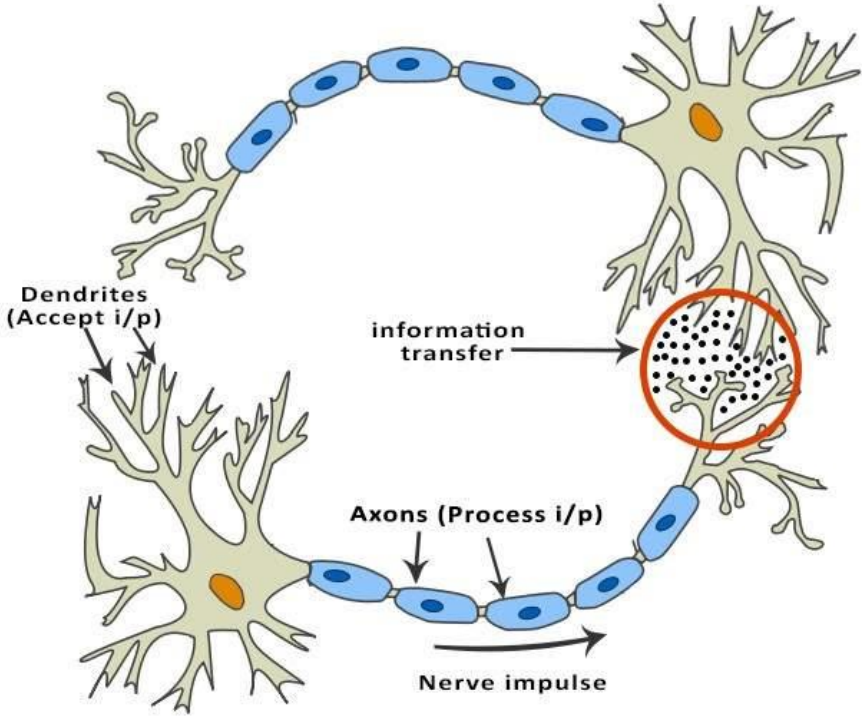
SPEECH RECOGNITION



These and more are enabling new & improved applications

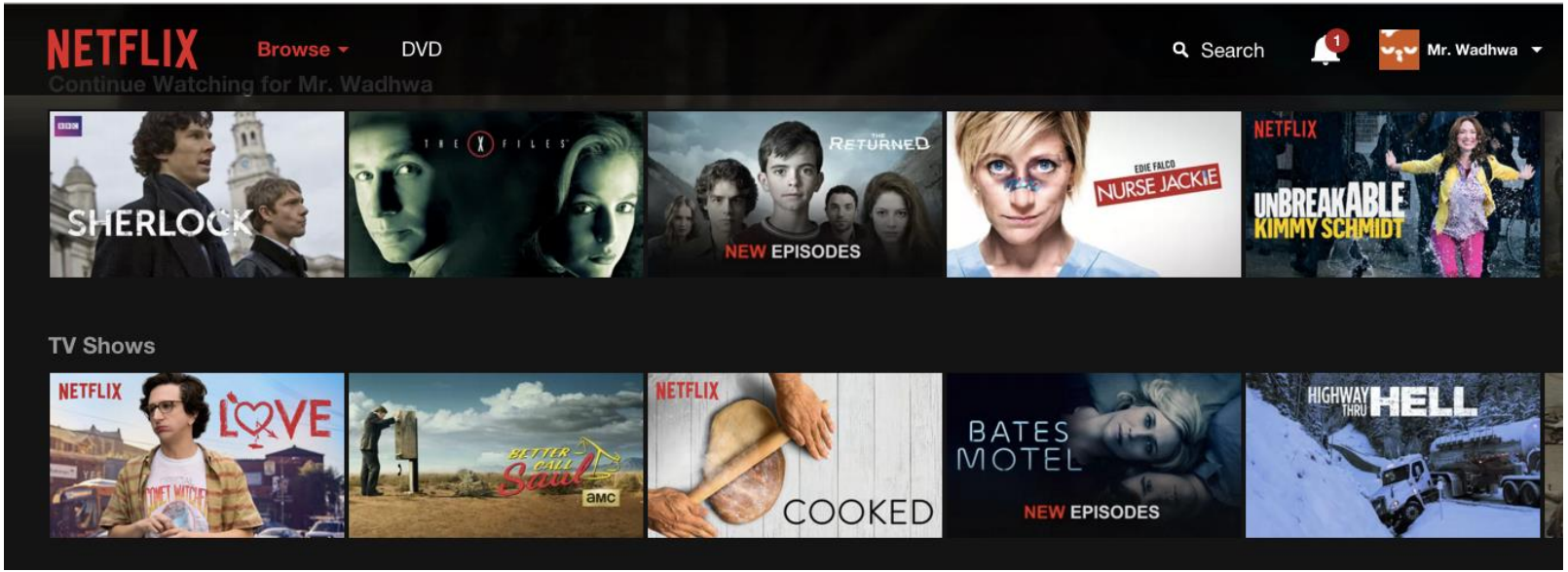
WHAT IS DEEP LEARNING

INSPIRED BY HUMAN BRAIN



CASE STUDY: RECOMMENDATION SYSTEMS

NETFLIX

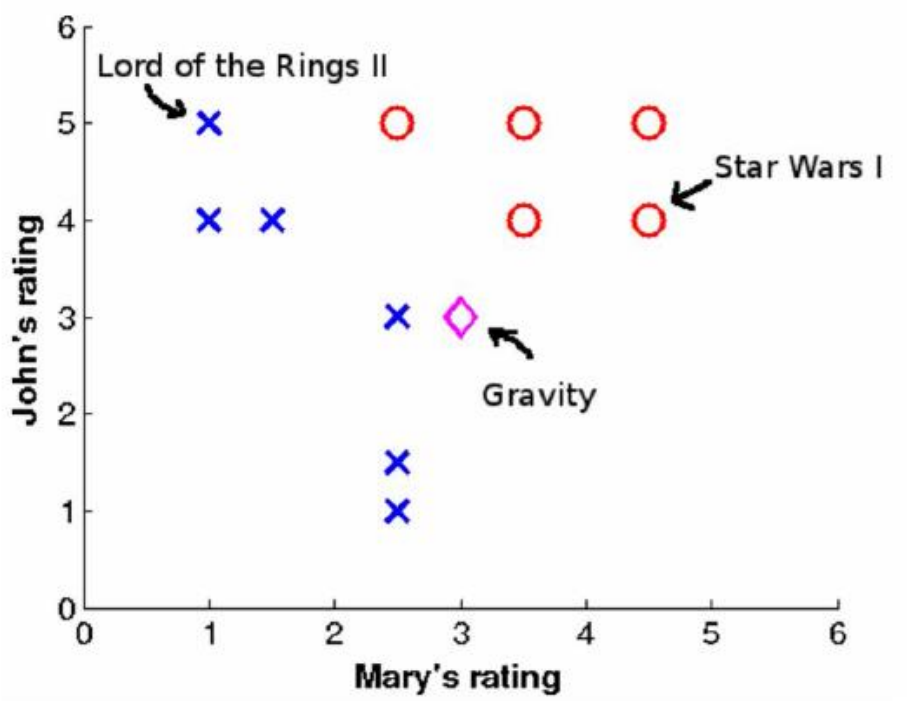


Will Nancy like Gravity?

Let’s ask close friends Mary and John, who already watched it and rated between 1-5.

Movie	Mary's Rating	John's Rating	Does Nancy like?
Lord of the Rings 2	1	5	No
...	...	...	...
Star Wars 1	4.5	4	Yes
Gravity	3	3	?

NETFLIX


Lord of the Rings II
Star Wars I
Gravity
John's rating
Mary's rating
0
1
2
3
4
5
6

A decision function can be as simple as weighted linear combination of friends:

$$h_{\theta,b} = \theta_1 x_1 + \theta_2 x_2 + b$$

$$h_{\theta,b} = \theta^T x + b$$

- Labels: “I like it” -> 1 “I don’t like it” -> 0
- Inputs: Mary’s rating, John’s rating

ACTIVATION FUNCTION

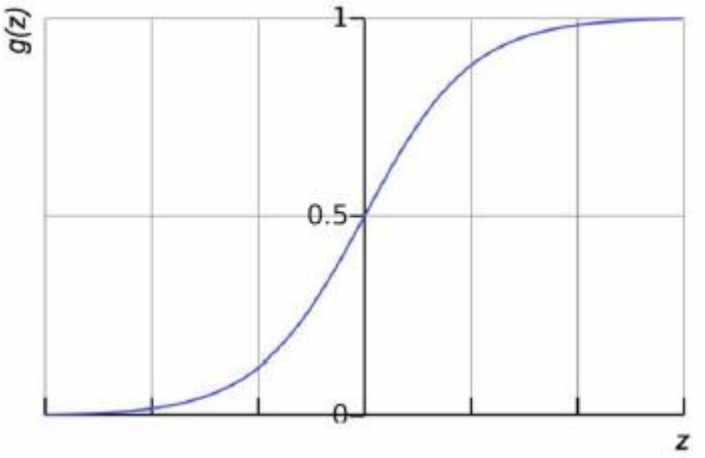
This function has a problem. Its values are unbounded.

We want its output to be in the range of 0 and 1.

$$h_{\theta,b} = g(\theta^T x + b),$$

where $g(z)$ is sigmoid function.

$$g(z) = \frac{1}{1 + exp(-z)}$$

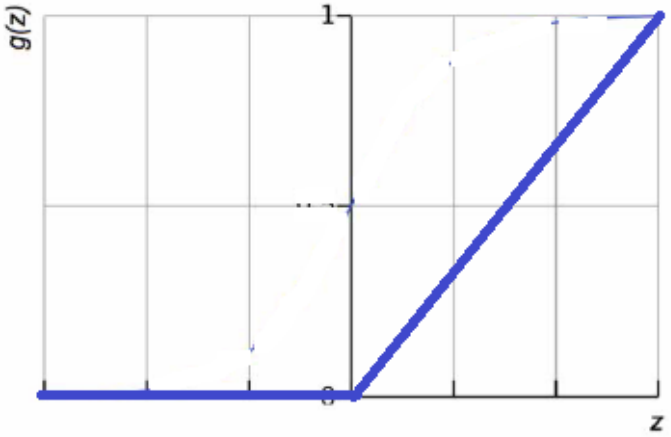


ACTIVATION FUNCTION

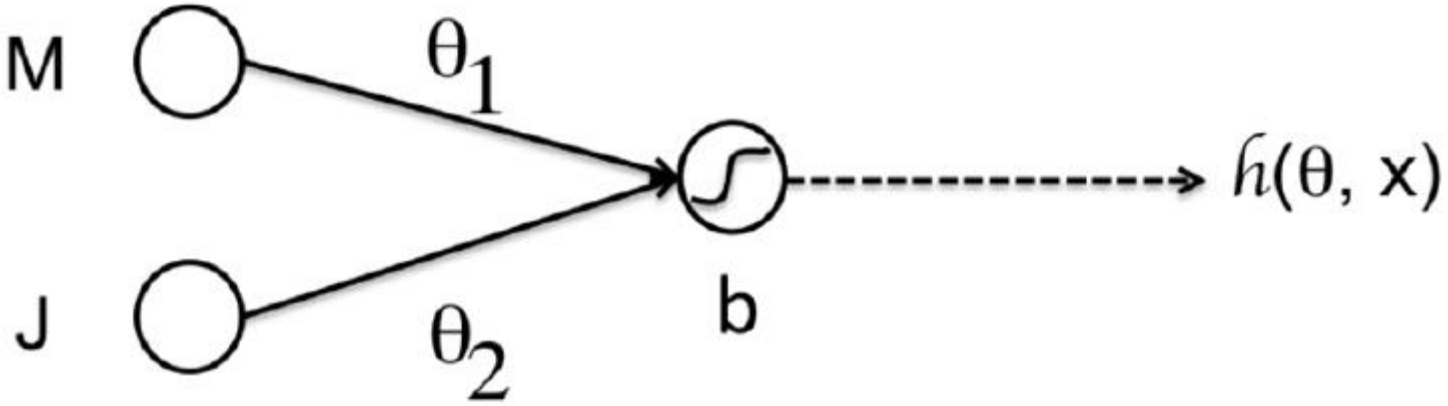
This function has a problem. Its values are unbounded.
We want its output to be in the range of 0 and 1.

ReLU (Rectified Linear Unit)

f(x) = max(0,x)



ANOTHER WAY OF REPRESENTING THE MODEL



LEARN FROM DATA

We will use the past data to learn θ, b to approximate y. In particular, we want to obtain θ, b such that:

$h_{\theta,b}(x^{(1)}) \approx y^{(1)}$ where $x^{(1)}$ is my friend's ratings for 1st movie.

$h_{\theta,b}(x^{(2)}) \approx y^{(2)}$ where $x^{(2)}$ is my friend's ratings for 2nd movie.

...

$h_{\theta,b}(x^{(m)}) \approx y^{(m)}$ where $x^{(m)}$ is my friend's ratings for mth movie.

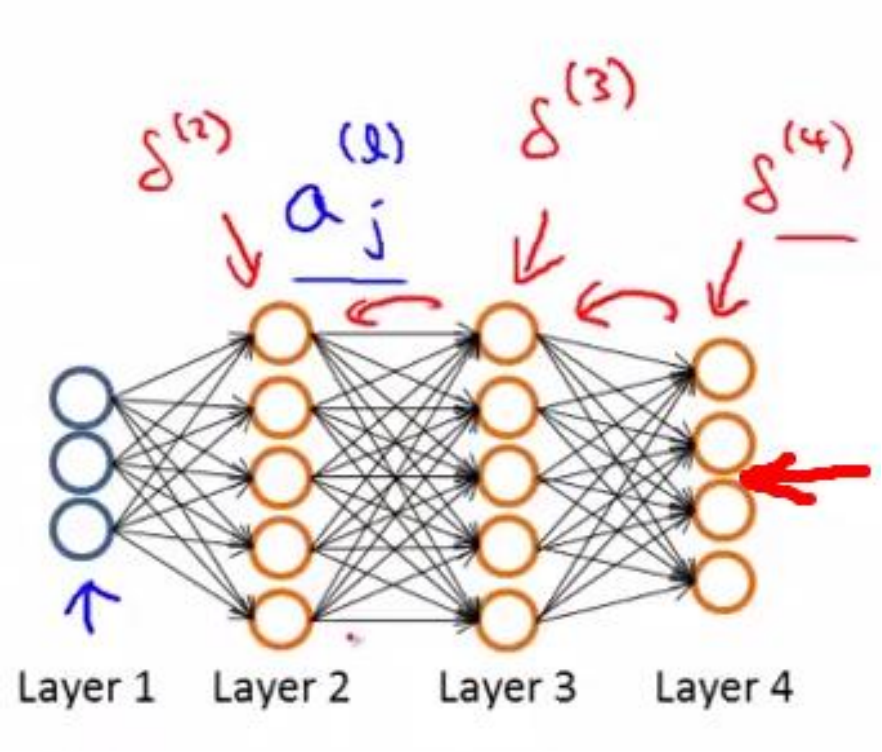
COST FUNCTION

To find values of θ and b we can minimize the following *cost function*:

$$J(\theta, b) = \left(h_{\theta,b}\left(x^{(1)}\right) - y^{(1)}\right)^2 + \left(h_{\theta,b}\left(x^{(2)}\right) - y^{(2)}\right)^2 + \ \ldots + \left(h_{\theta,b}\left(x^{(m)}\right) - y^{(m)}\right)^2$$

$$J(\theta, b) = \sum_{i=1}^{m} \left(h_{\theta,b}\left(x^{(i)}\right) - y^{(i)}\right)^2$$

BACKPROPOGATION

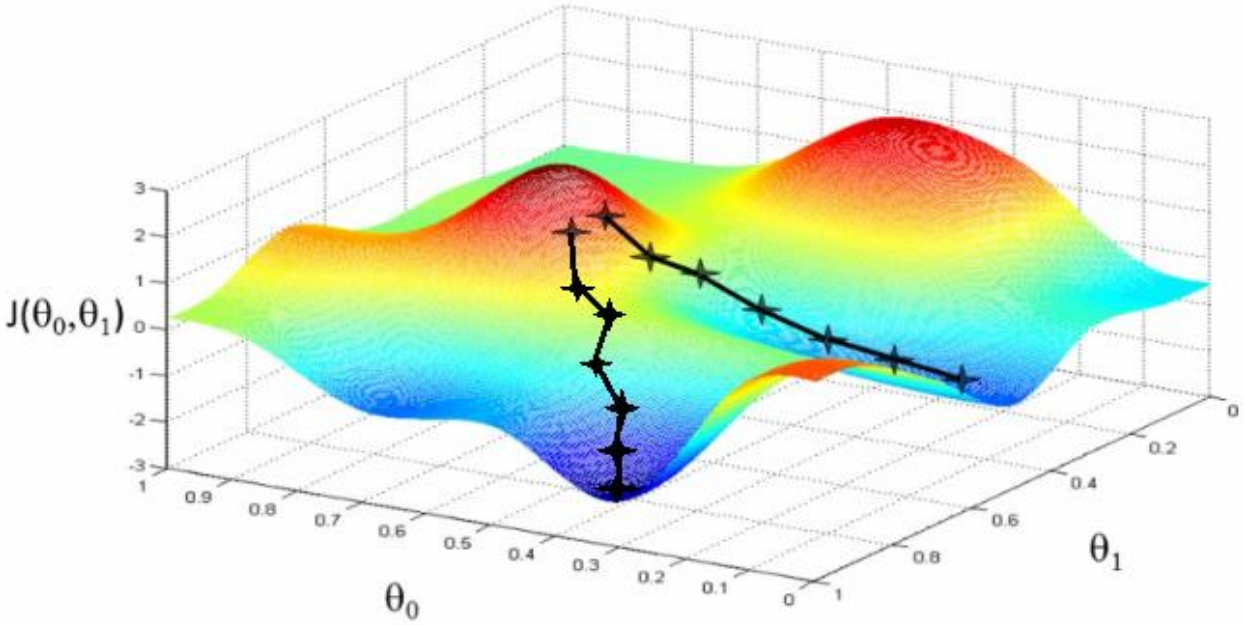


STOCHASTIC GRADIENT DESCENT

Use Stochastic Gradient Descent (SGD):

$$\theta_1 = \theta_1 - \alpha\Delta\theta_1$$
$$\theta_2 = \theta_2 - \alpha\Delta\theta_2$$
$$b = b - \alpha\Delta b$$

STOCHASTIC GRADIENT DESCENT



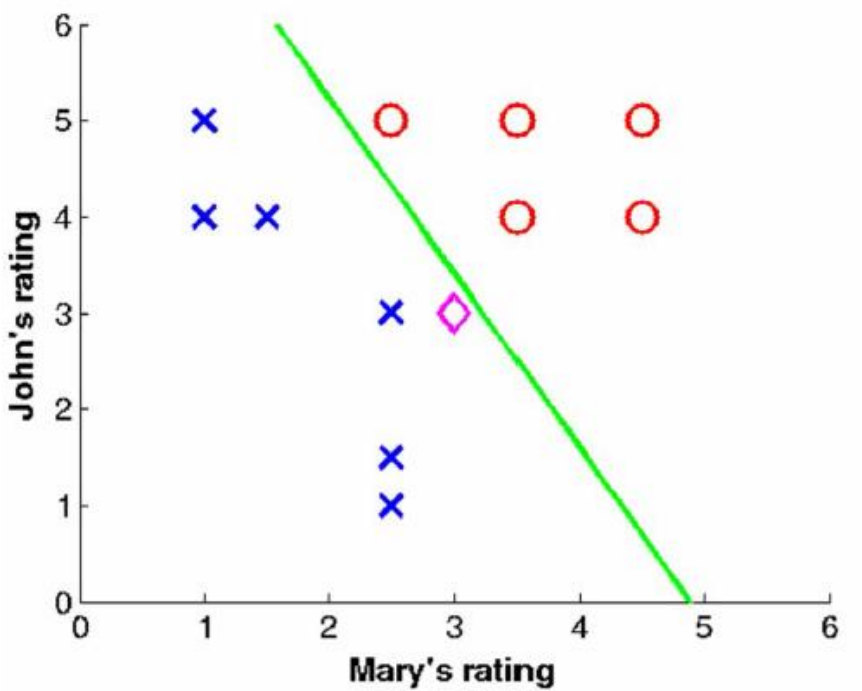
STEPS

1. Initialize the parameters θ and b at random
2. Pick a random example $\{x^{(i)}, y^{(i)}\}$
3. Compute the partial derivatives of θ_1, θ_2, b
4. Update parameters using:

$$\theta_1 = \theta_1 - \alpha\Delta\theta_1$$
$$\theta_2 = \theta_2 - \alpha\Delta\theta_2$$
$$b = b - \alpha\Delta b$$

Stop it when parameters don't change much, or after a certain number of iterations.

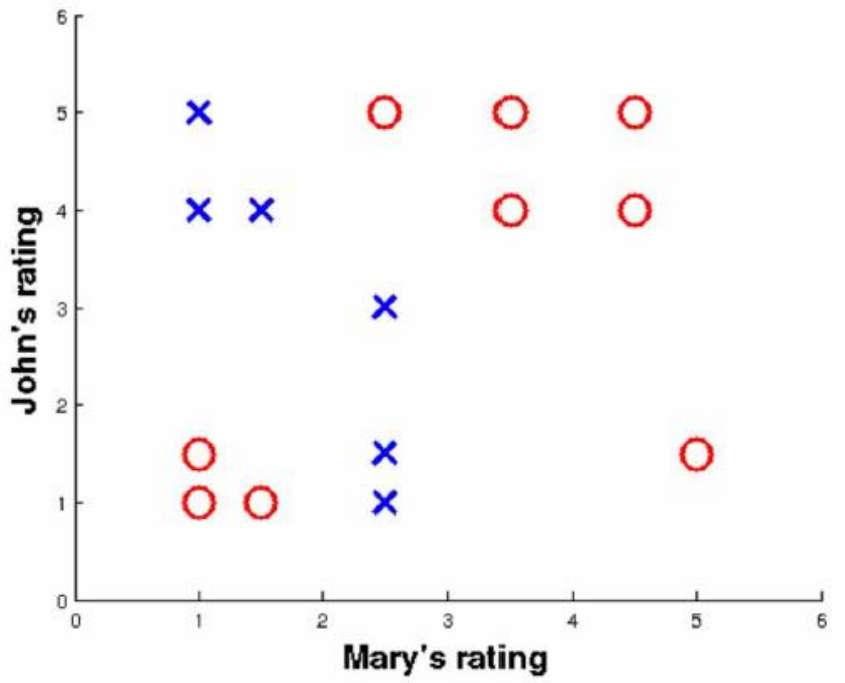
NETFLIX



Gravity movie is slightly on the “don’t watch” side.

With this data set, it seems like ”not watching it” makes more sense.

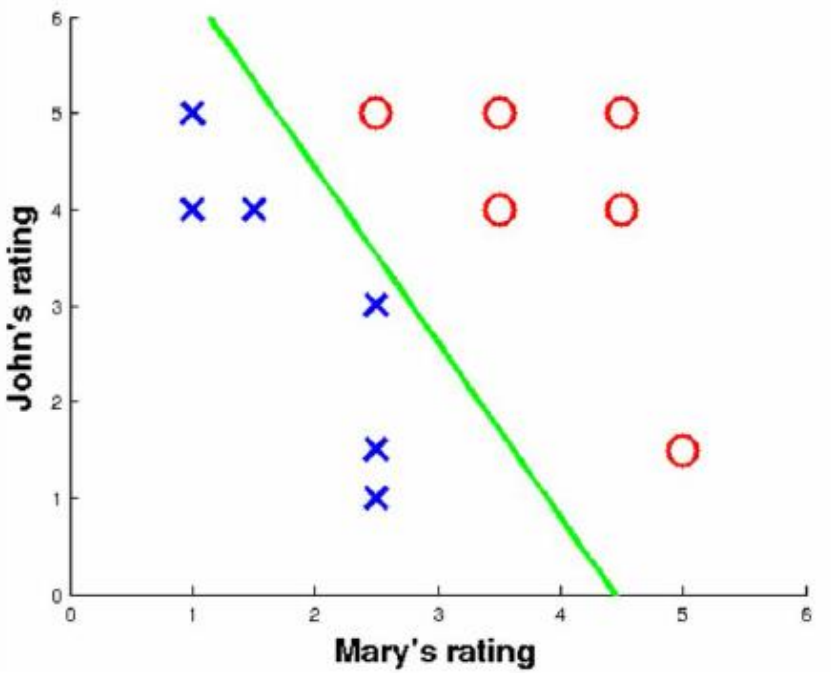
NETFLIX

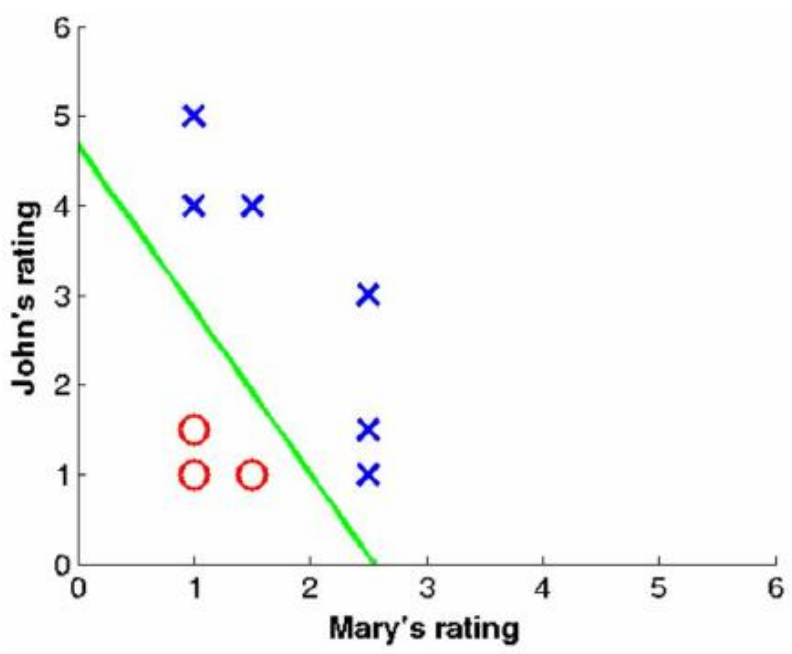


Nancy likes some of the movies both Mary and John rated poorly.

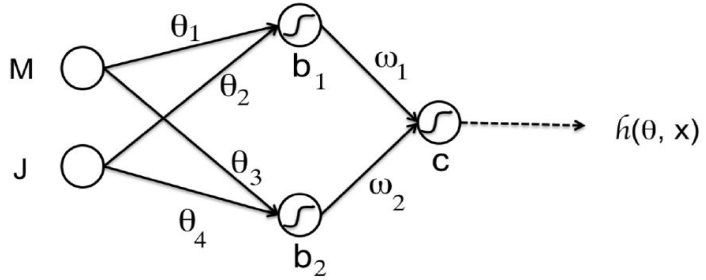
How can I have a linear decision boundary separate these?

NETFLIX

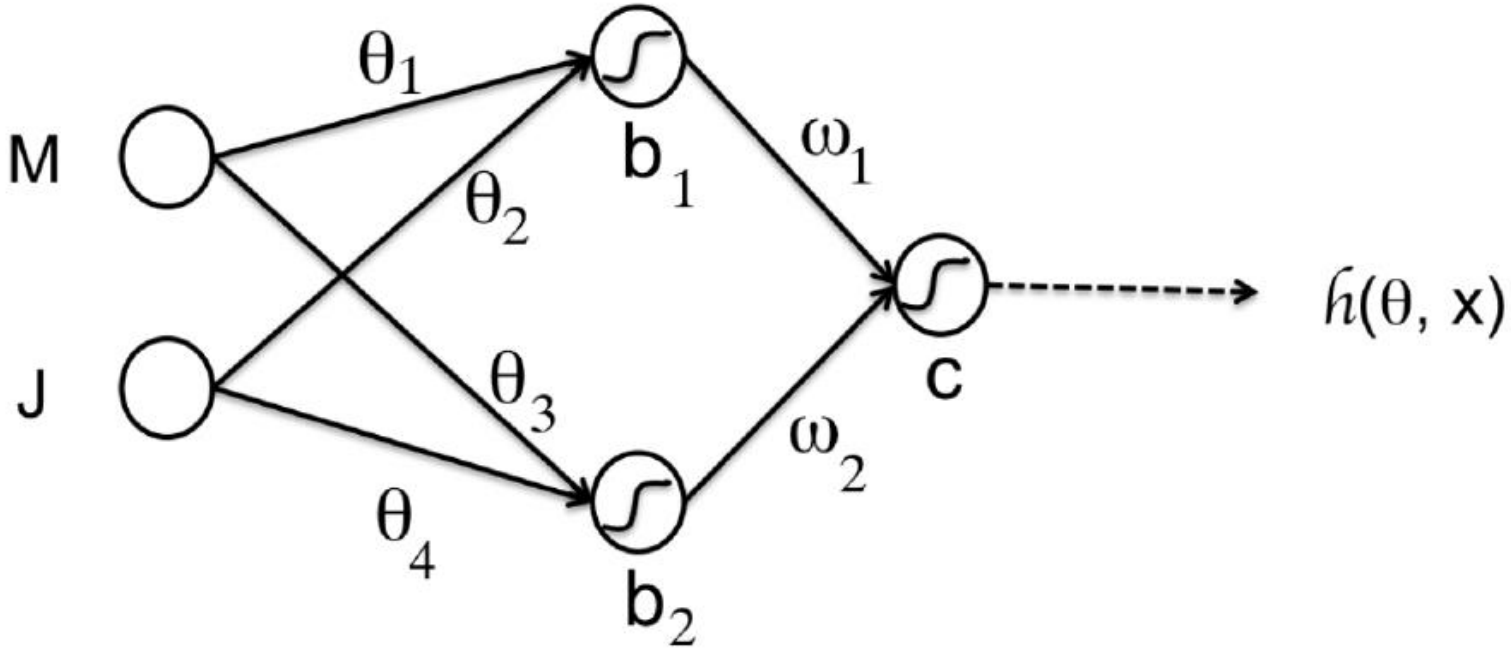

John's rating
Mary's rating
0
1
2
3
4
5
6


John's rating
Mary's rating
0
1
2
3
4
5
6

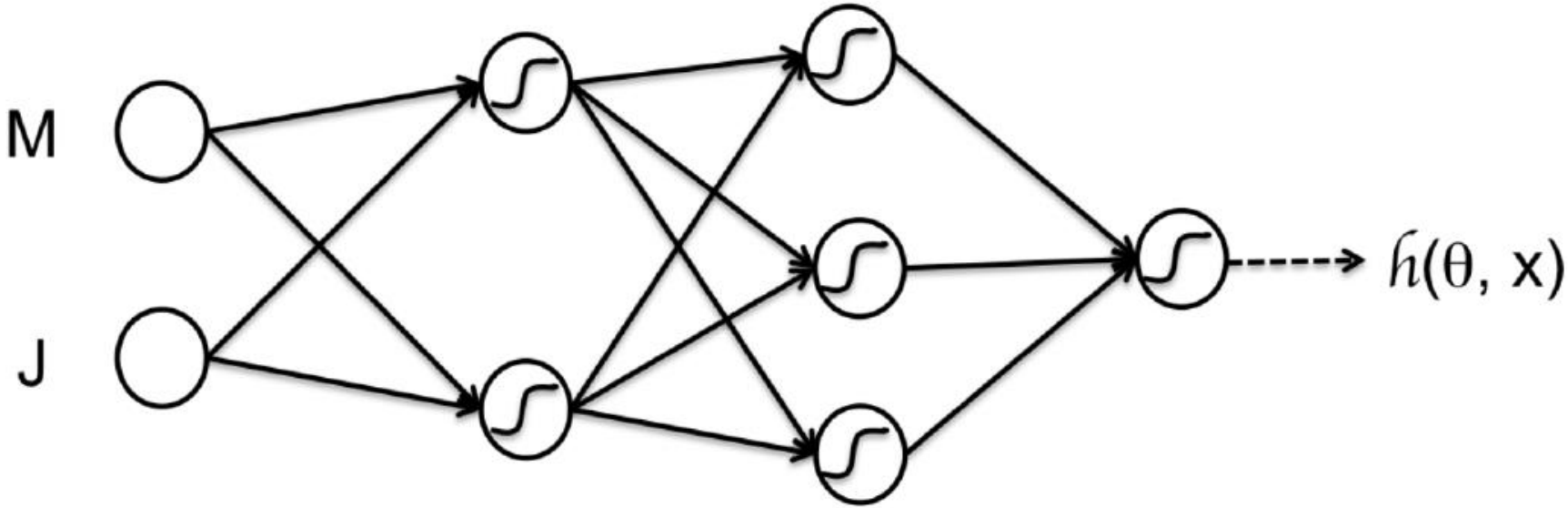
Movie	Output by decision function *h1*	Output by decision function *h2*	Does Nancy like?
Lord of the Rings 2	$h_1(x^{(1)})$	$h_2(x^{(1)})$	No
…	…	…	…
Star Wars 1	$h_1(x^{(n)})$	$h_2(x^{(n)})$	Yes
Gravity	$h_1(x^{(n+1)})$	$h_2(x^{(n+1)})$	?



THIS IS THE NEURAL NETWORK

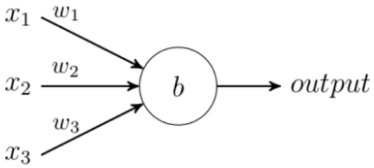


A DEEPER NEURAL NETWORK



DEEP LEARNING: BASIC STRUCTURE

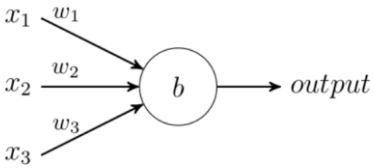
BASIC SINGLE NEURON



$$u_n = \sum_{j=1}^{m} w_{nj} x_j$$

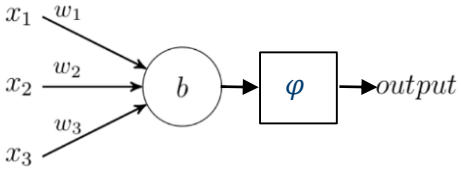
DEEP LEARNING: BASIC STRUCTURE

BASIC SINGLE NEURON



$$u_n = \sum_{j=1}^{m} w_{nj} x_j$$

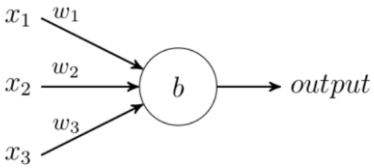
SINGLE NEURON WITH ACTIVATION



φ → Activation function

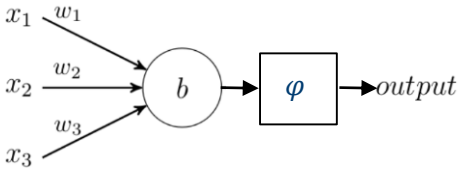
DEEP LEARNING: BASIC STRUCTURE

BASIC SINGLE NEURON



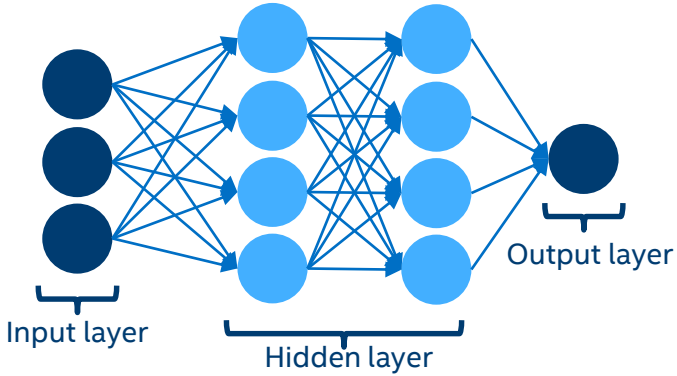
$$u_n = \sum_{j=1}^{m} w_{nj} x_j$$

SINGLE NEURON WITH ACTIVATION



φ → Activation function

BASIC STRUCTURE WITH TWO HIDDEN LAYERS



CLASSICAL MACHINE LEARNING VS DEEP LEARNING

CLASSIC ML

Using optimized functions or algorithms to extract insights from data

Training Data*

Algorithms
- Random Forest
- Support Vector Machines
- Regression
- Naïve Bayes
- Hidden Markov
- K-Means Clustering
- Ensemble Methods
- More...

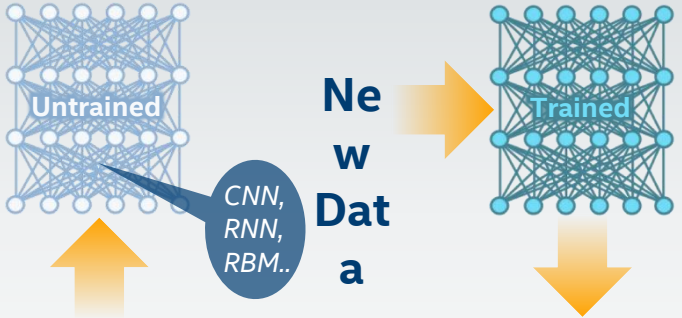
Inference, Clustering, or Classification

New Data*

*Note: not all classic machine learning functions require training

DEEP LEARNING

Using massive labeled data sets to train deep (neural) graphs that can make inferences about new data



Step 1: Training

Hours to Days in Cloud

Use massive labeled dataset (e.g. 10M tagged images) to iteratively adjust weighting of neural network connections

Step 2: Inference

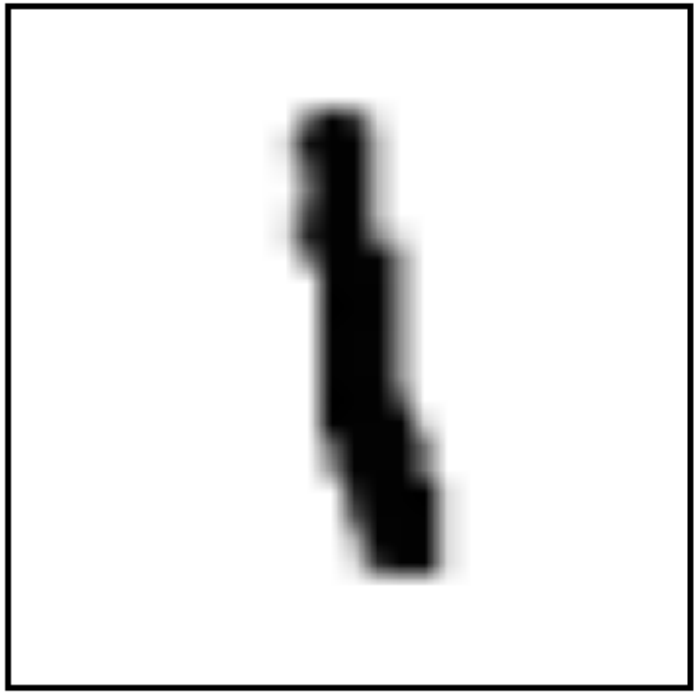
Real-Time at Edge/Cloud

Form inference about new input data (e.g. a photo) using trained neural network

VANILLA
NEURAL NETWORKS

USE CASE: HANDWRITTEN DIGITS (MNIST)

USE CASE: HANDWRITTEN DIGITS (MNIST)

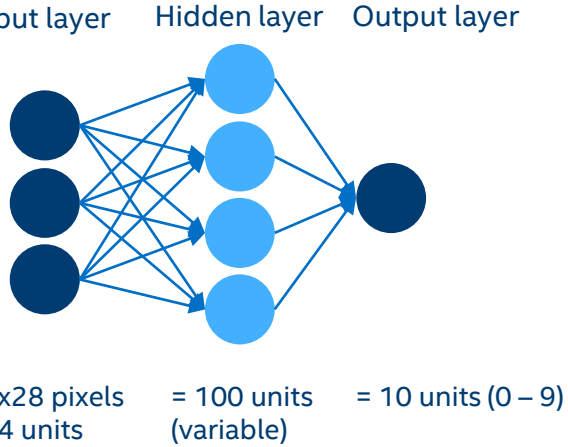


≈

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

USE CASE: HANDWRITTEN DIGITS (MNIST)

MNIST DATASET
28x28 Pixels



= 28x28 pixels
= 784 units

= 100 units
(variable)

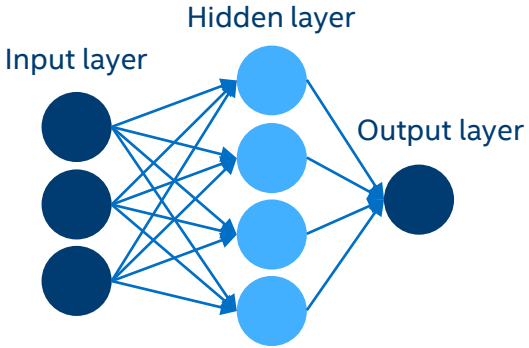
= 10 units (0 – 9)

TOTAL PARAMETERS

$W_{\text{input} \rightarrow \text{hidden}}$	784 x 100
b_{hidden}	100
$W_{\text{hidden} \rightarrow \text{output}}$	100 x 10
B_{output}	10

$$u_n = \sum_{j=1}^{m} w_{nj} x_j$$

TRAINING



1) Initialize weights
2) Forward pass
3) Calculate cost
4) Backward pass
5) Update weights

Output	Ground Truth
0.2	0.0
0.0	0.0
0.5	1
0.0	0.0
0.1	0.0
0.4	0.0
0.2	0.0
0.0	0.0
0.1	0.0
0.0	0.0

Cost function =
C(output, truth)

HANDS-ON WORK

Case Study: MNIST by Softmax Regression

USE CASE: HANDWRITTEN DIGITS (MNIST)

Softmax Regression

iPython notebook:

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

CONVOLUTIONAL NEURAL NETWORKS (CNN)

Convolutional Neural Networks (CNN)

Essentially neural networks that use convolution in place of general matrix multiplication in at least one of their layers.

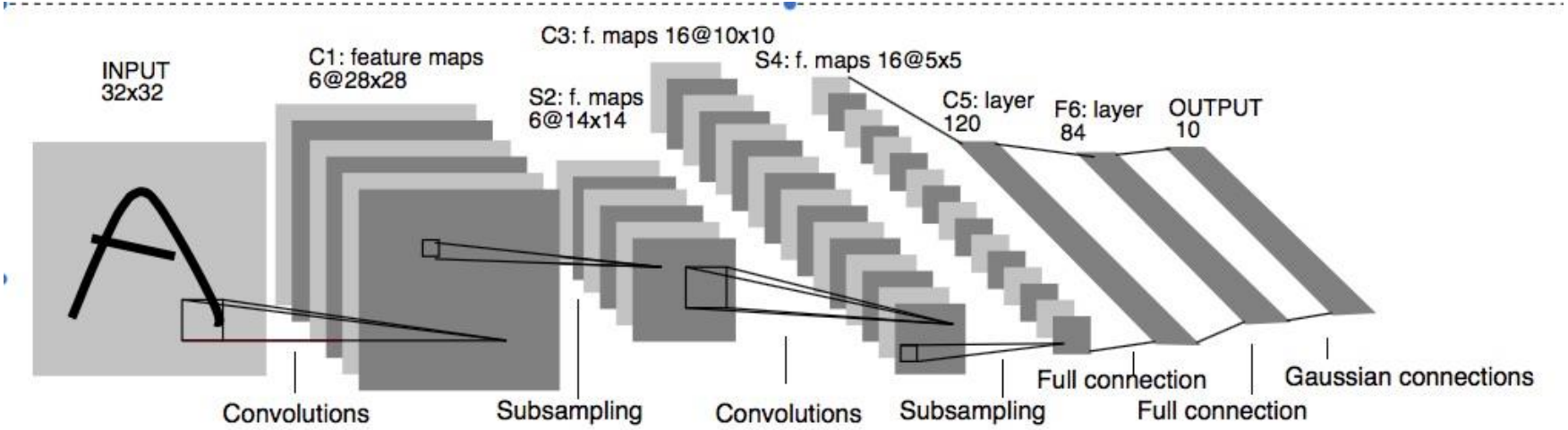
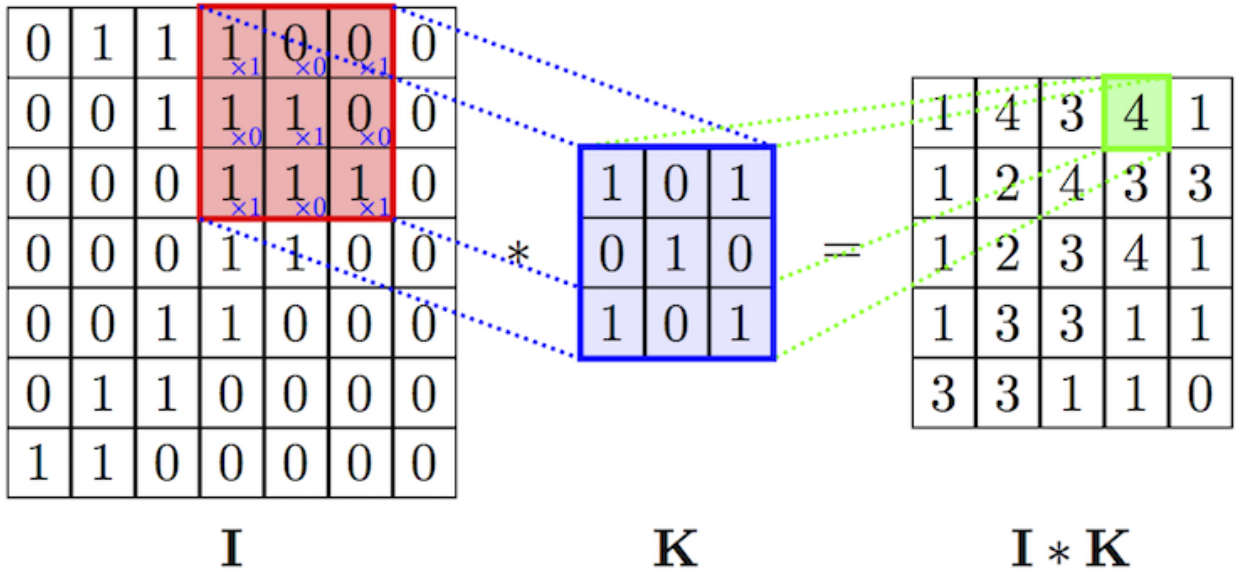


Fig. 2. Architecture of LeNet-5, a Convolutional Neural Network, here for digits recognition. Each plane is a feature map, i.e. a set of units whose weights are constrained to be identical.

CONVOLUTION



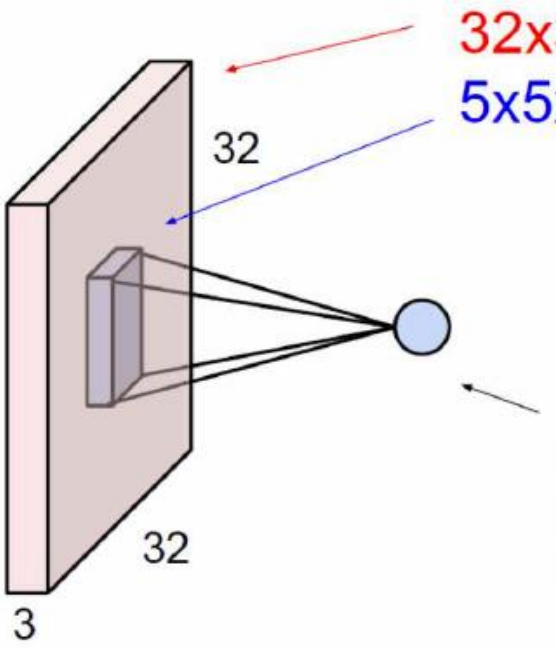
CONVOLUTION

*

1	0	-1
2	0	-2
1	0	-1

CONVOLUTION

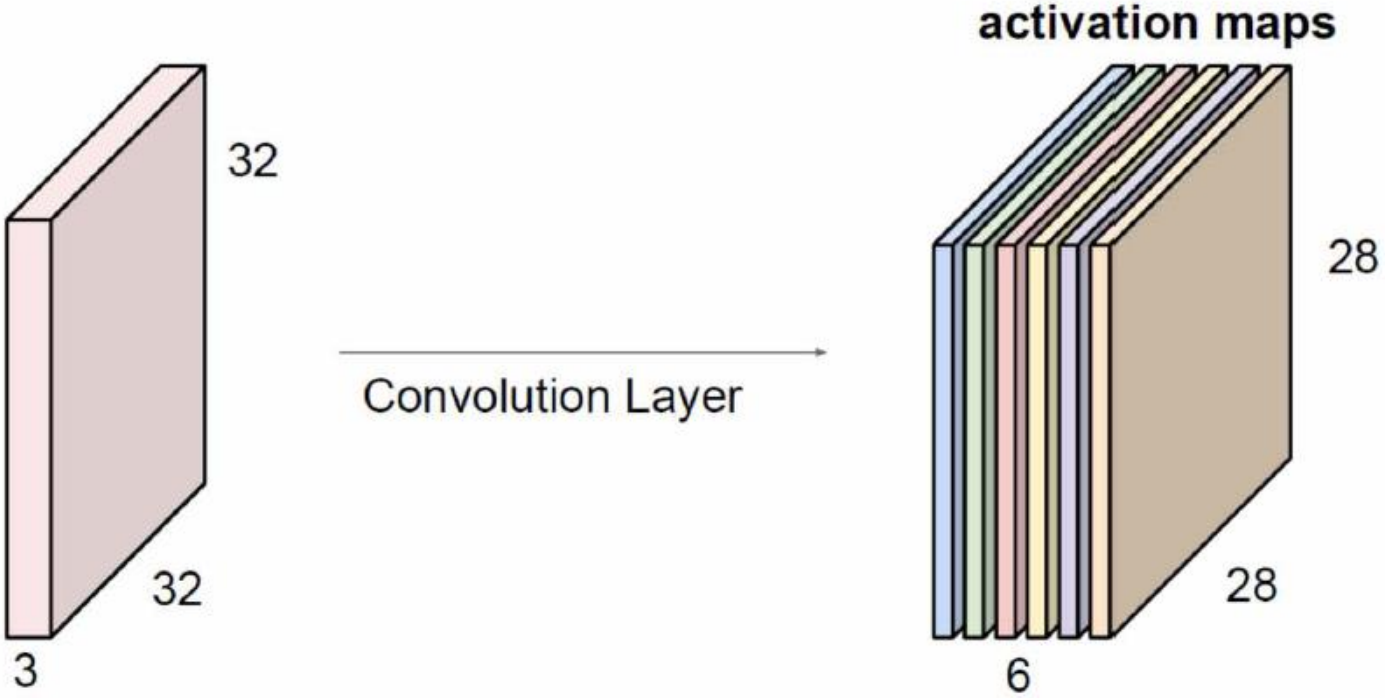
Convolution Layer



1 number:
the result of taking a dot product between the filter and a small 5x5x3 chunk of the image
(i.e. 5*5*3 = 75-dimensional dot product + bias

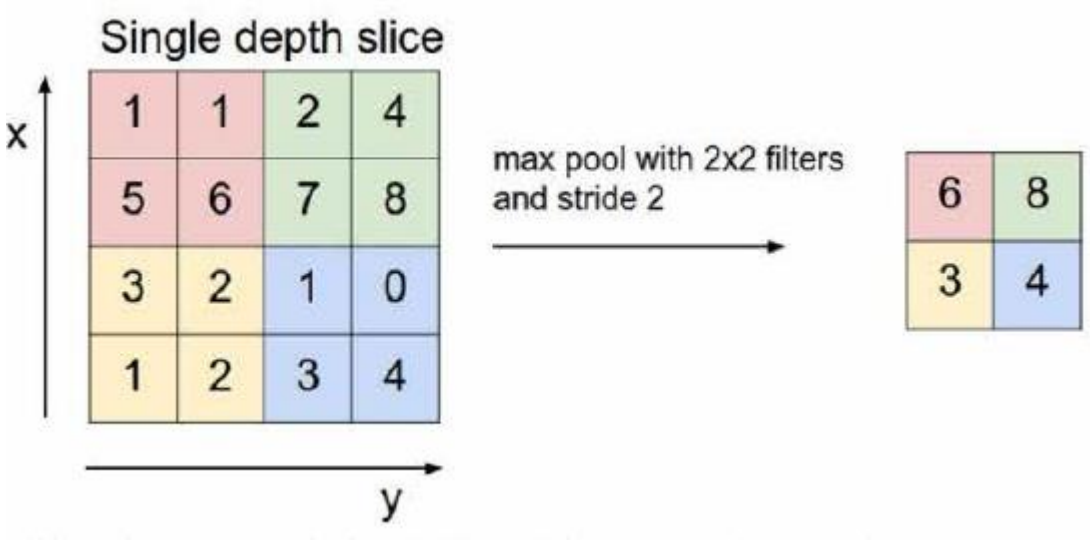
$$w^T x + b$$

Convolution Layer

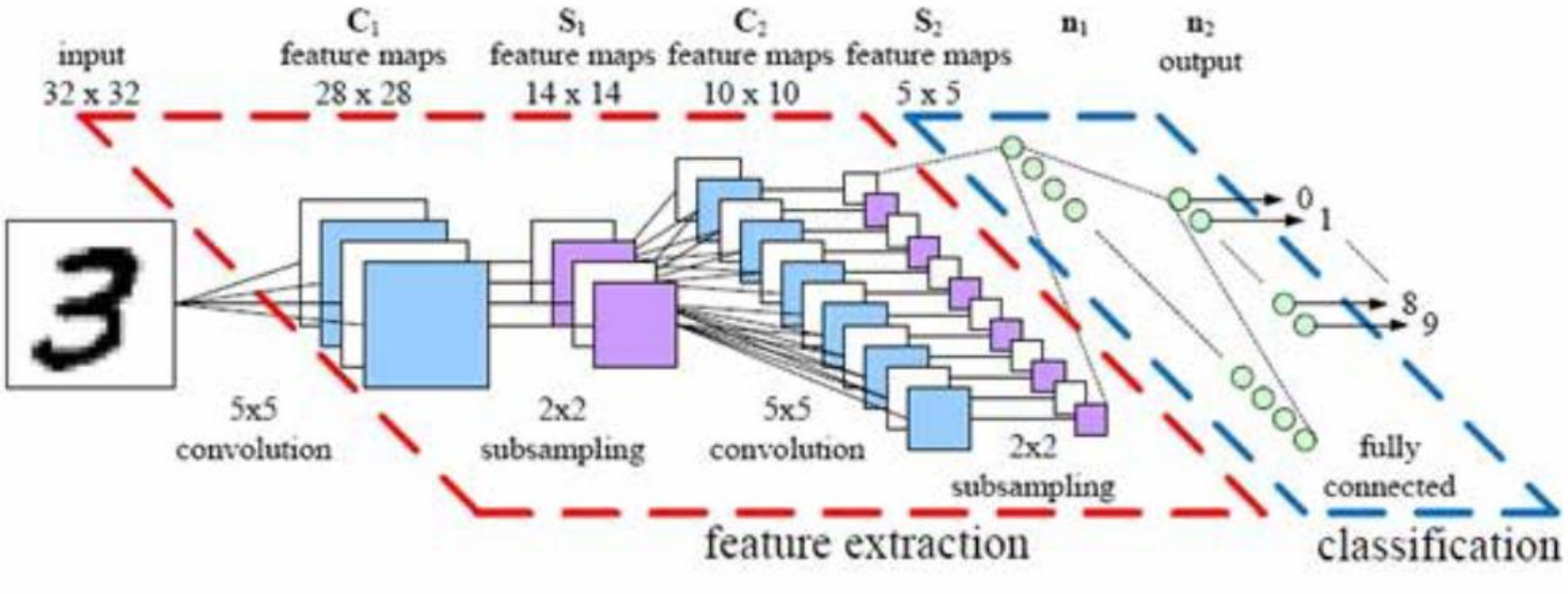


We stack these up to get a “new image” of size 28x28x6!

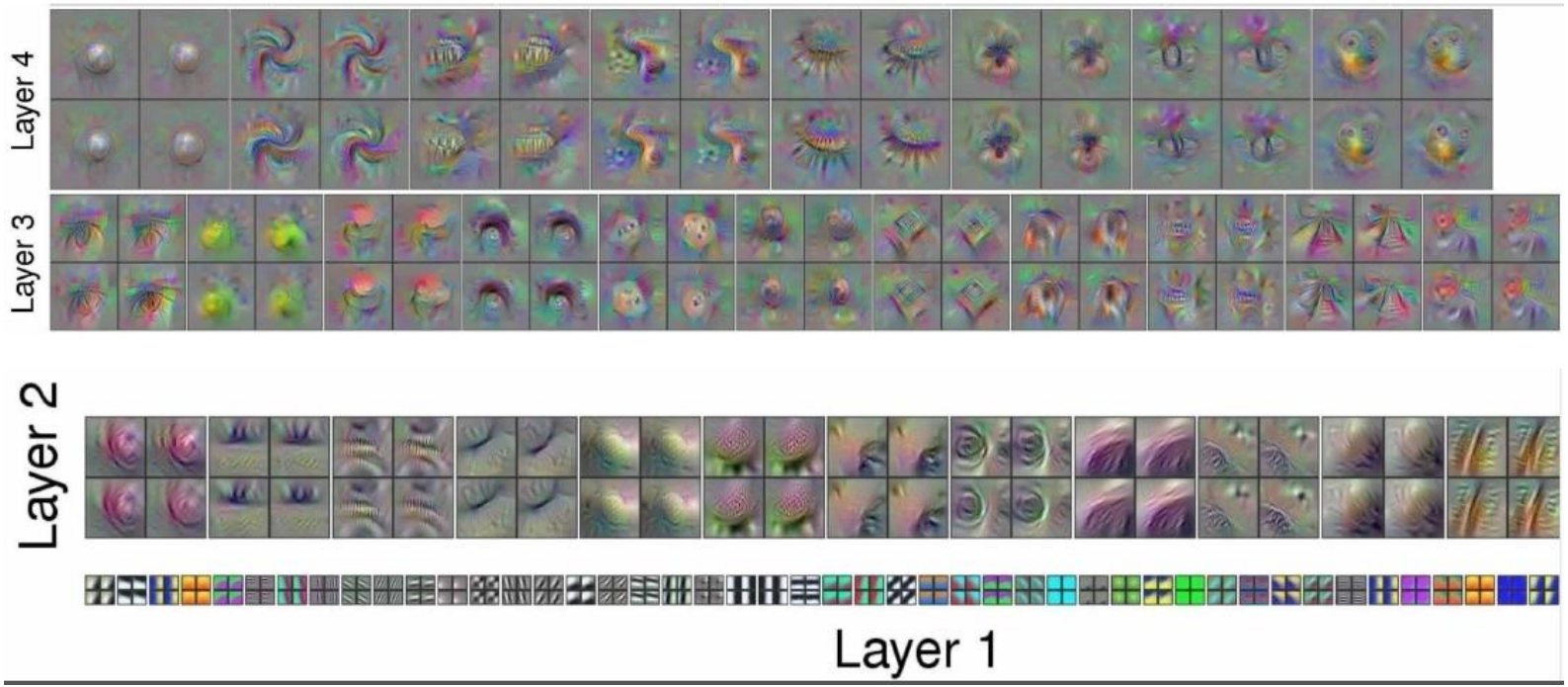
Max Pooling


Single depth slice
x
y
1 1 2 4
5 6 7 8
3 2 1 0
1 2 3 4
max pool with 2x2 filters
and stride 2
6 8
3 4

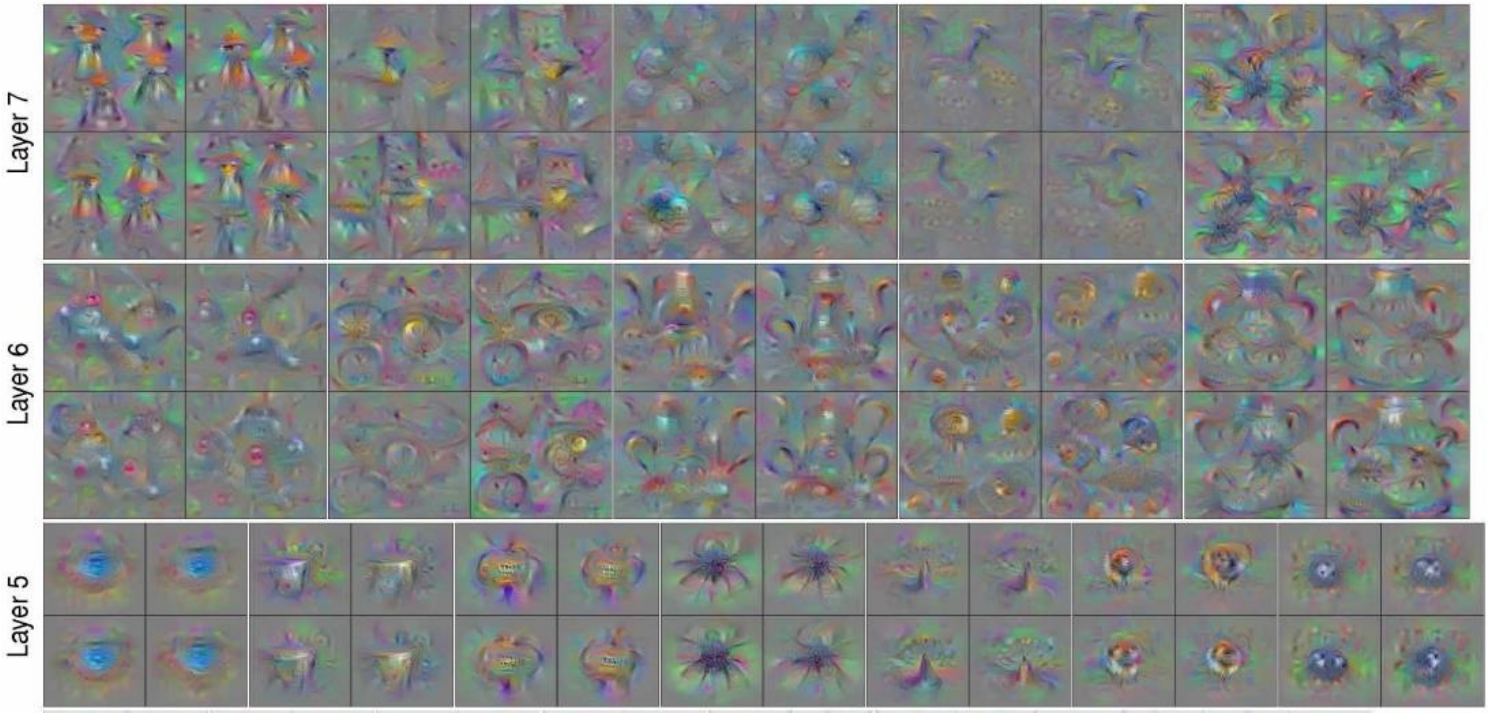
CNN Pipeline



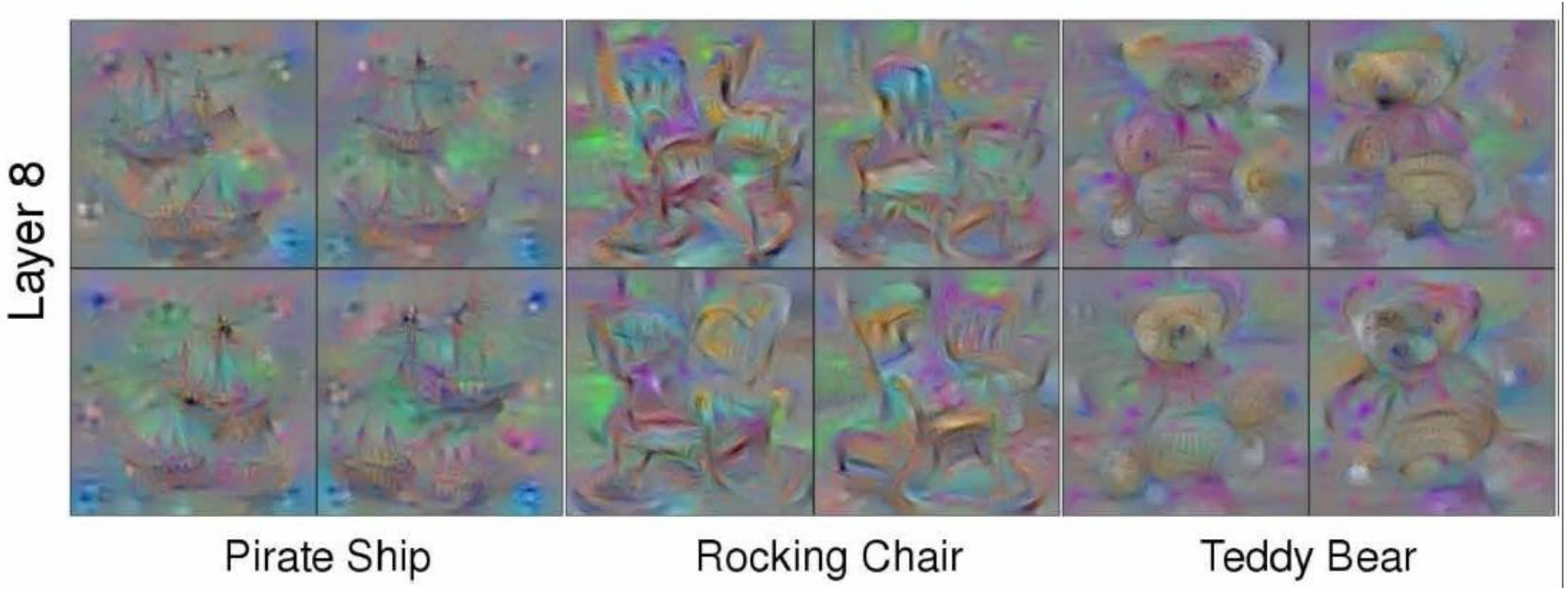
Visualizing Neurons



Visualizing Neurons



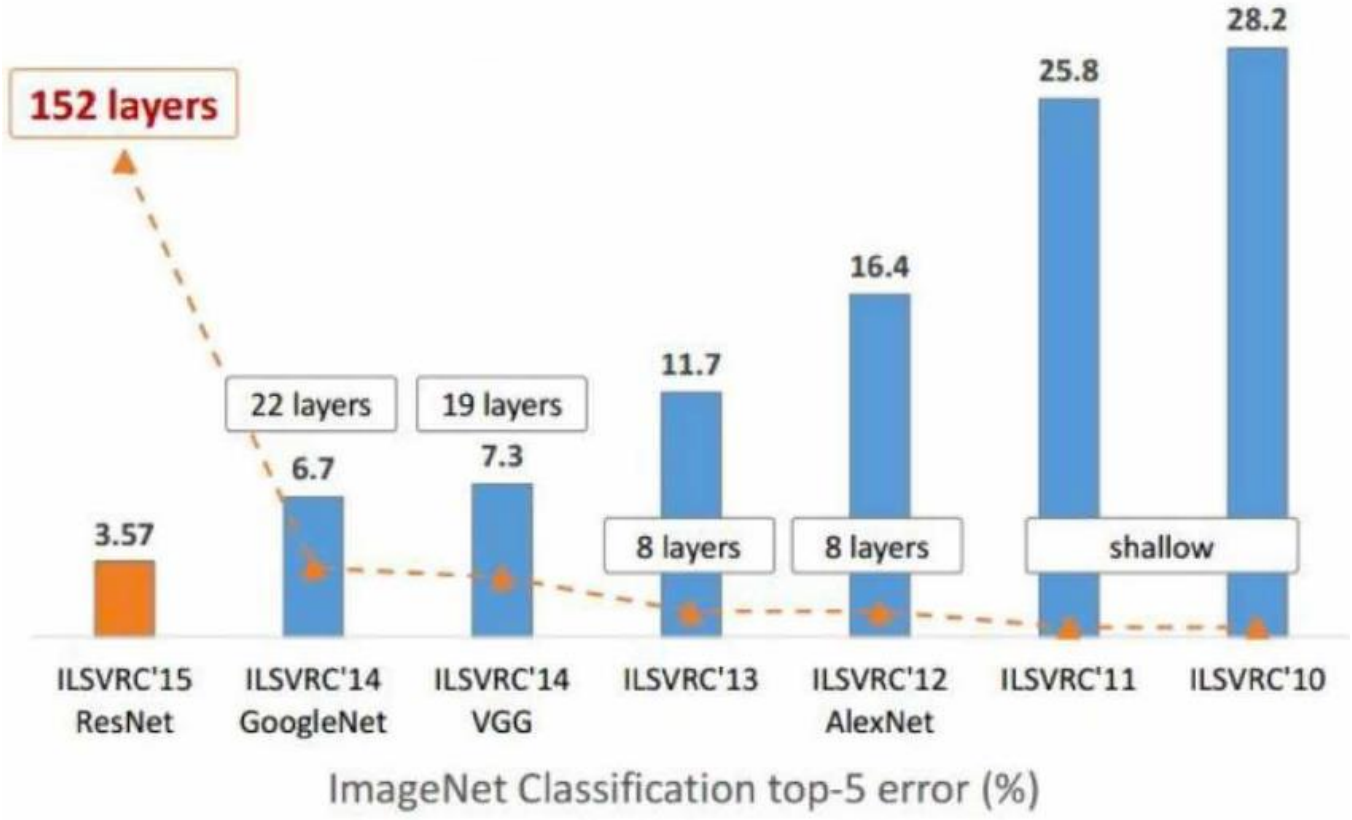
Visualizing Neurons



ImageNet Large Scale Visual Recognition Competition (ILSVRC)

- ~1M images
- 1K object categories in the training set
- Task: What is the object in the image?
- Classify the image into one of 1000 categories
- Evaluation
  - Is one of the best 5 guesses is correct?
  - Human performance is around 5.1% error.

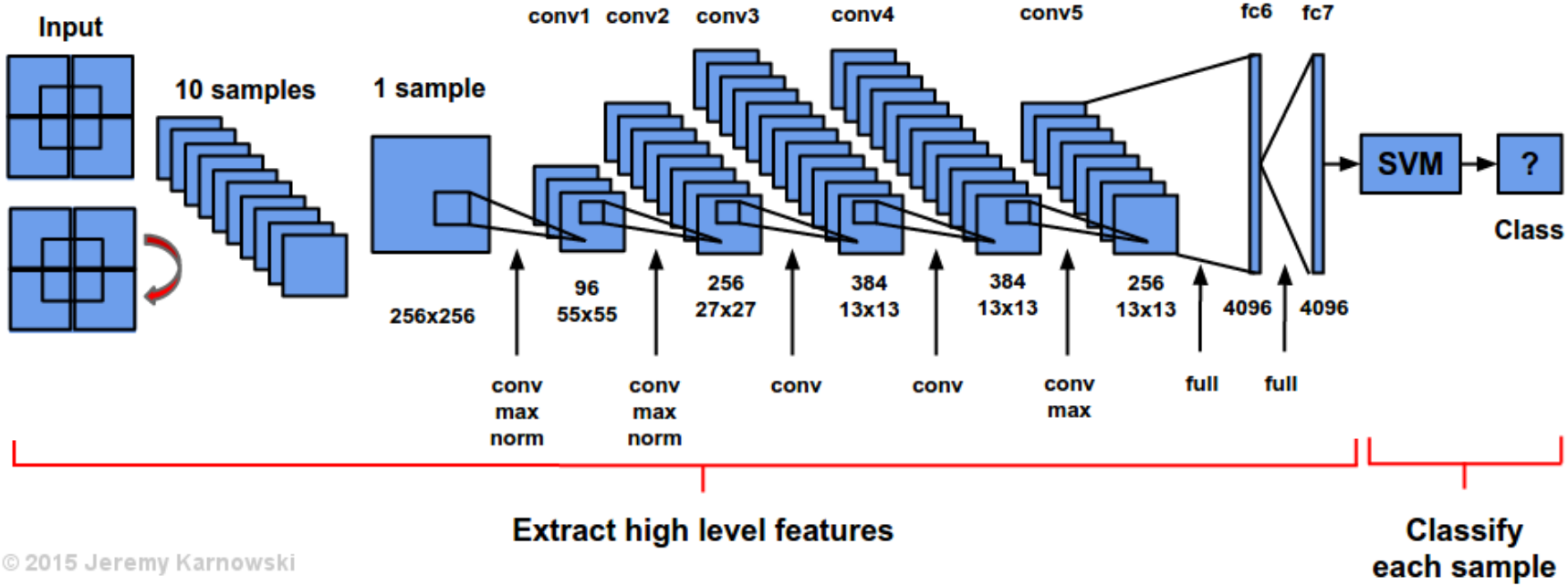
Evolution of Depth



AlexNet (2012)

8 layers

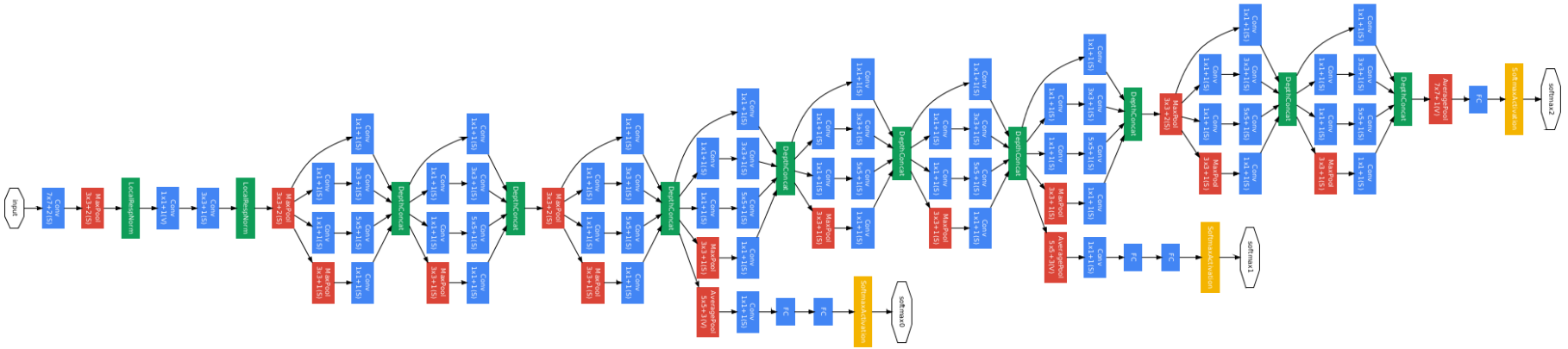
16,4 error rate



GoogleNet (2014)

22 layers

6,7 error rate



ResNet (2015)

152 layers
3,57 error rate

HANDS-ON WORK

Case Study: MNIST with Convolutional Neural Networks

USE CASE: HANDWRITTEN DIGITS (MNIST)

Convolutional Neural Networks

iPython notebook:

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

HANDS-ON WORK

Case Study: CIFAR10 with Convolutional Neural Networks

USE CASE: HANDWRITTEN DIGITS (MNIST)

Convolutional Neural Networks

iPython notebook:

https://raw.githubusercontent.com/mstfldmr/IntelAIWorkshop/master/TFLearn-CIFAR.ipynb

HANDS-ON WORK

Case Study: CIFAR10 and MNIST
with Intel Deep Learning Training Tool

INTEL® DEEP LEARNING TRAINING TOOL

BETA Available Now

Accelerate Deep Learning Development

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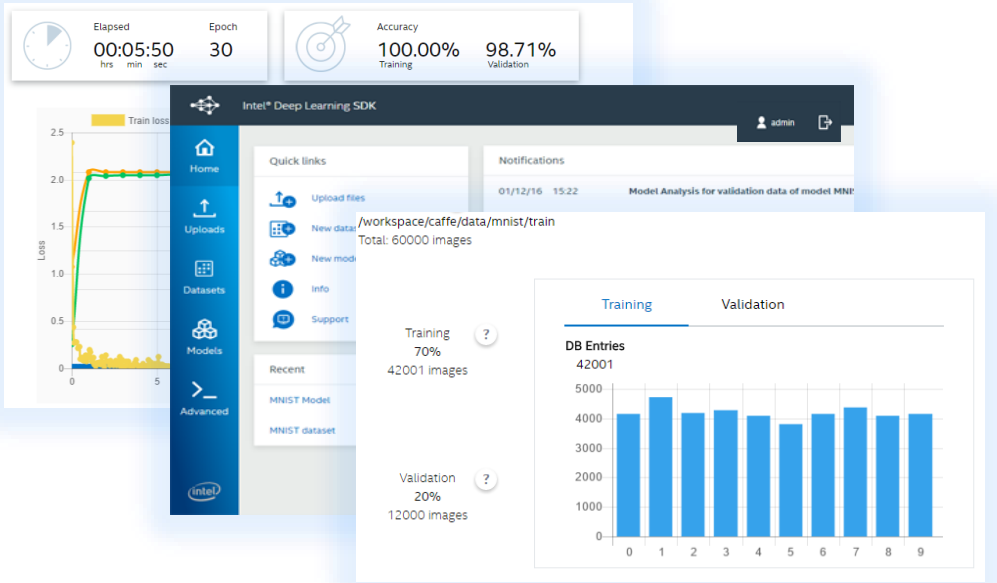
- **FREE** for data scientists and software developers to develop, train & deploy deep learning
- **Simplify installation** of Intel optimized frameworks and libraries
- **Increase productivity** through simple and highly-visual interface
- **Enhance deployment** through model compression and normalization
- **Facilitate integration** with full software stack via inference engine



software.intel.com/deep-learning-sdk

OTHER TYPES OF DEEP LEARNING

RECURRENT NEURAL NETWORKS

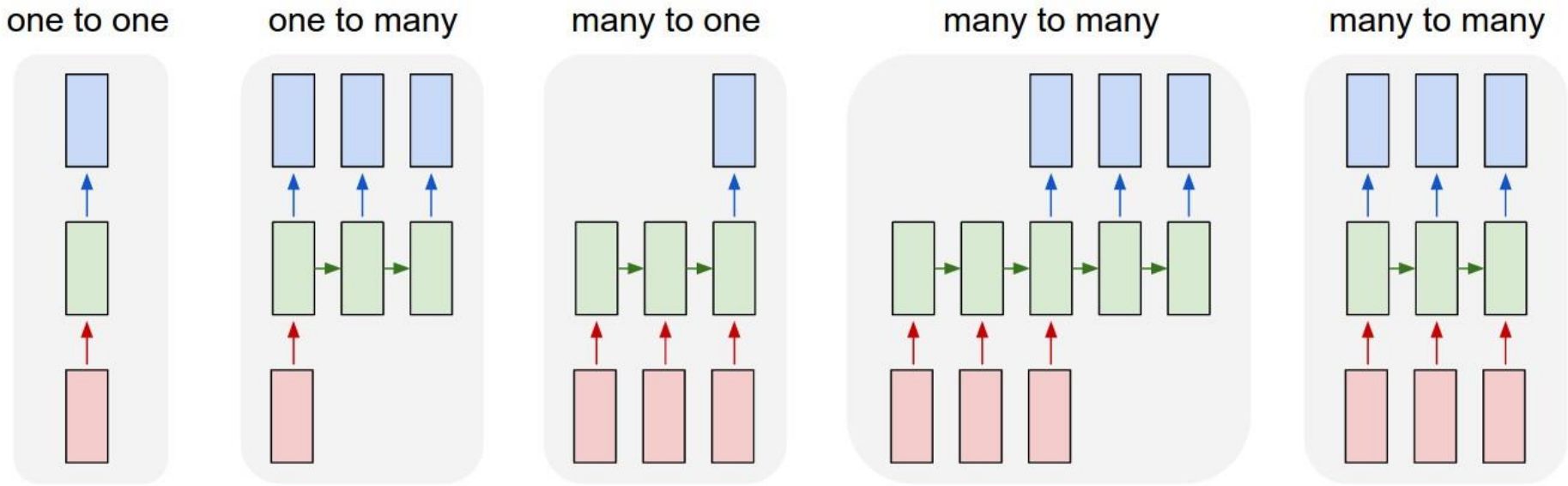


Image Classification

Image Captioning

Sentiment Analysis

Google Translate

Video Frame Classification

Red: input; Blue: output, Green: RNN state

GENERATIVE ADVERSARIAL NETWORKS

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TOOLS

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Movidius Neural Compute Stick

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Spark MLlib BigDL

TensorFlow

mxnet

theano

neon

Caffe

torch

E2E Tool

LIBRARIES

python Intel Dist

Intel® DAAL

Intel® Nervana™ Graph*

Intel® MKL MKL-DNN Intel® MLSL

Movidius MvTensor Library

Associative Memory Base

HARDWARE

Compute: Intel Atom, Quark, Core i7, Xeon, Xeon Phi, Arria 10, Lake Crest*

Memory & Storage

Networking

Visual Intelligence: RealSense Technology, Movidius an intel company

UNLEASH FULL POTENTIAL

*Coming 2017

LIBRARIES, FRAMEWORKS & TOOLS

	Intel® MKL	MKL-DNN	Intel® MLSL	Intel® Data Analytics Acceleration Library (DAAL)	Intel® Distribution for Python	Open Source Frameworks	Intel Deep Learning SDK	Intel® Computer Vision SDK
High Level Overview	Computation primitives; high performance math primitives granting low level of control	Computation primitives; free open source DNN functions for high-velocity integration with deep learning frameworks	Communication primitives; building blocks to scale deep learning framework performance over a cluster	Broad data analytics acceleration object oriented library supporting distributed ML at the algorithm level	Most popular and fastest growing language for machine learning	Toolkits driven by academia and industry for training machine learning algorithms	Accelerate deep learning model design, training and deployment	Toolkit to develop & deploying vision-oriented solutions that harness the full performance of Intel CPUs and SOC accelerators
Primary Audience	Consumed by developers of higher level libraries and Applications	Consumed by developers of the next generation of deep learning frameworks	Deep learning framework developers and optimizers	Wider Data Analytics and ML audience, Algorithm level development for all stages of data analytics	Application Developers and Data Scientists	Machine Learning App Developers, Researchers and Data Scientists.	Application Developers and Data Scientists	Developers who create vision-oriented solutions
Example Usage	Framework developers call matrix multiplication, convolution functions	New framework with functions developers call for max CPU performance	Framework developer calls functions to distribute Caffe training compute across an Intel® Xeon Phi™ cluster	Call distributed alternating least squares algorithm for a recommendation system	Call scikit-learn k-means function for credit card fraud detection	Script and train a convolution neural network for image recognition	Deep Learning training and model creation, with optimization for deployment on constrained end device	Use deep learning to do pedestrian detection

Find out more at http://software.intel.com/ai

NEXT STEPS...

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Getting Started

Machine Learning 101

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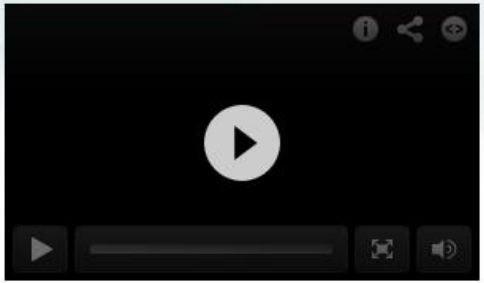
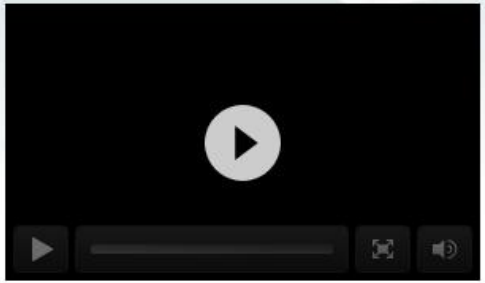


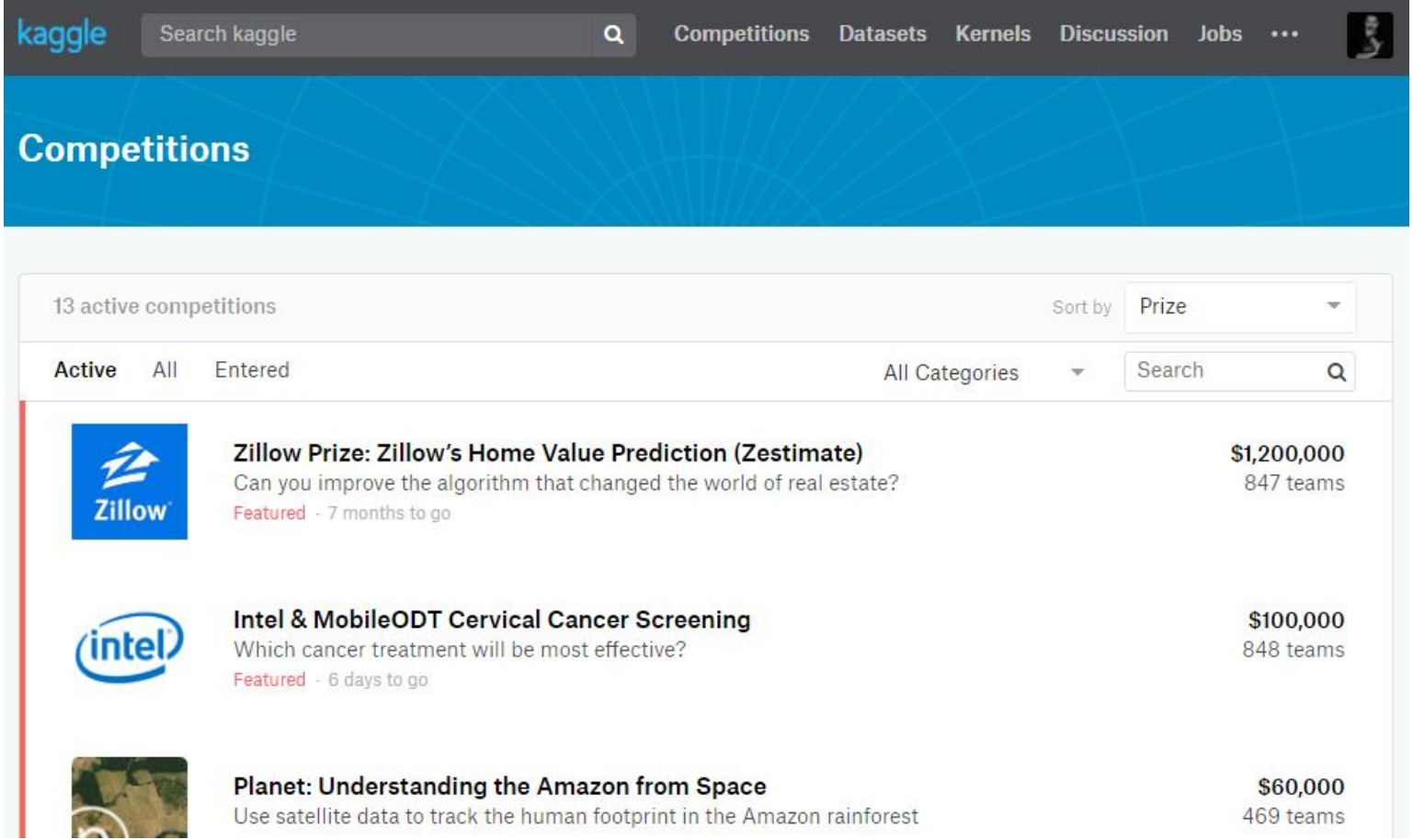
Deep Learning 101

In this webinar, we describe various deep learning uses and highlight those in which



Deep Learning 102: Neural Networks, Cost Functions, and More

https://software.intel.com/ai/academy



https://www.kaggle.com

SOURCES OF DATASETS

- https://www.kaggle.com/datasets
- http://tinyletter.com/data-is-plural
- http://www.kdnuggets.com/datasets
- https://github.com/caesar0301/awesome-public-datasets
- https://aws.amazon.com/public-datasets
- http://opendata.dc.gov
- https://www.data.gov/open-gov

Q&A

Software

STUDENT DEVELOPER PROGRAM