



ARTIFICIAL INTELLIGENCE WORKSHOP

MUSTAFA ALDEMIR, INTEL TURKEY

Codes & Slides: <http://bit.ly/ai-workshop>

MUSTAFA ALDEMIR



AI & IoT

Software Engineer

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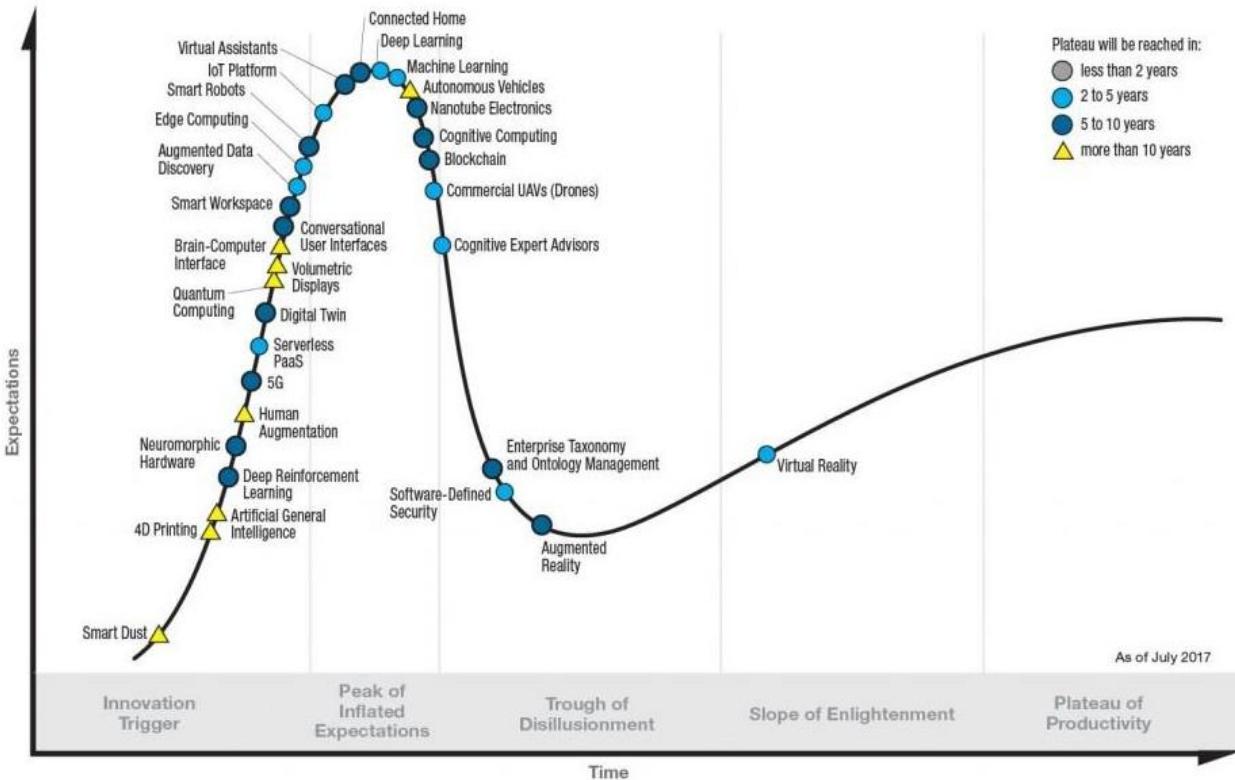
<http://bit.ly/mstfldmr>

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>

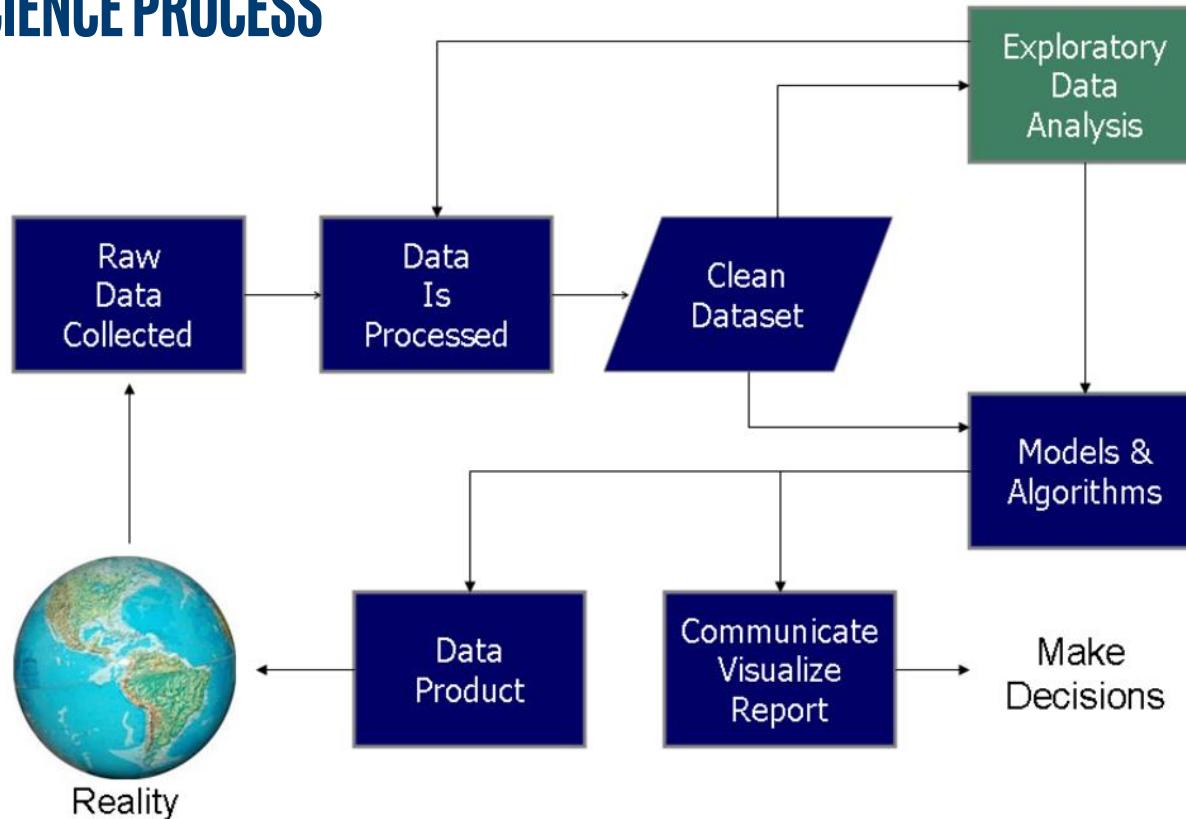
OUTLINE

- 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

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



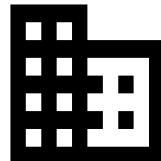
3,000GB



4,000GB

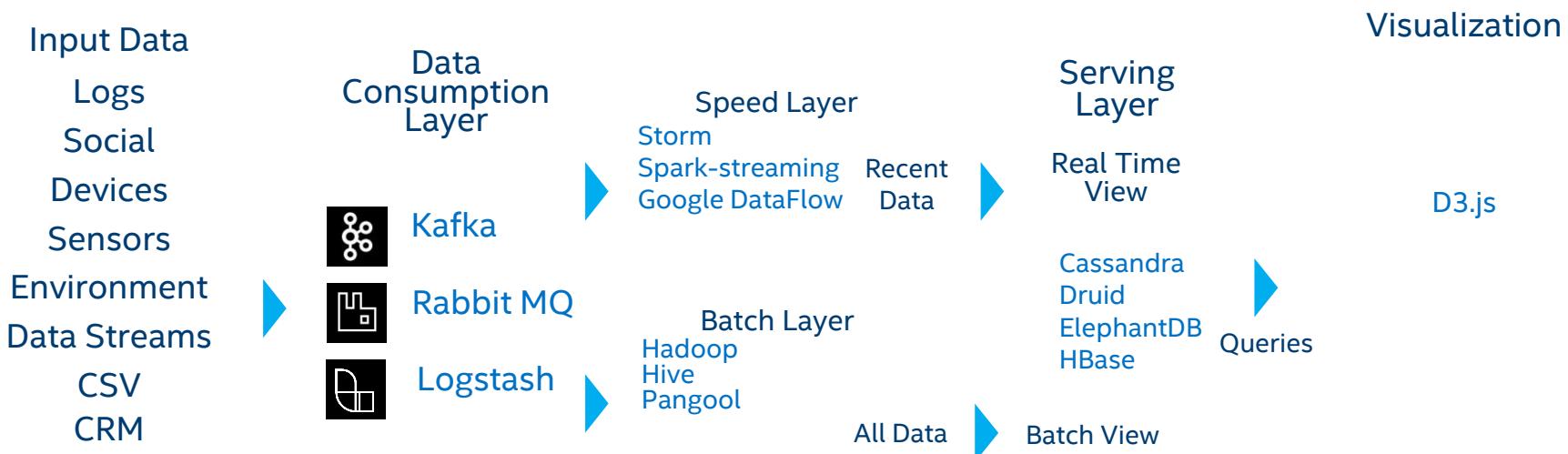


40,000GB



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

Smart Assistants
Chat bots
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

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



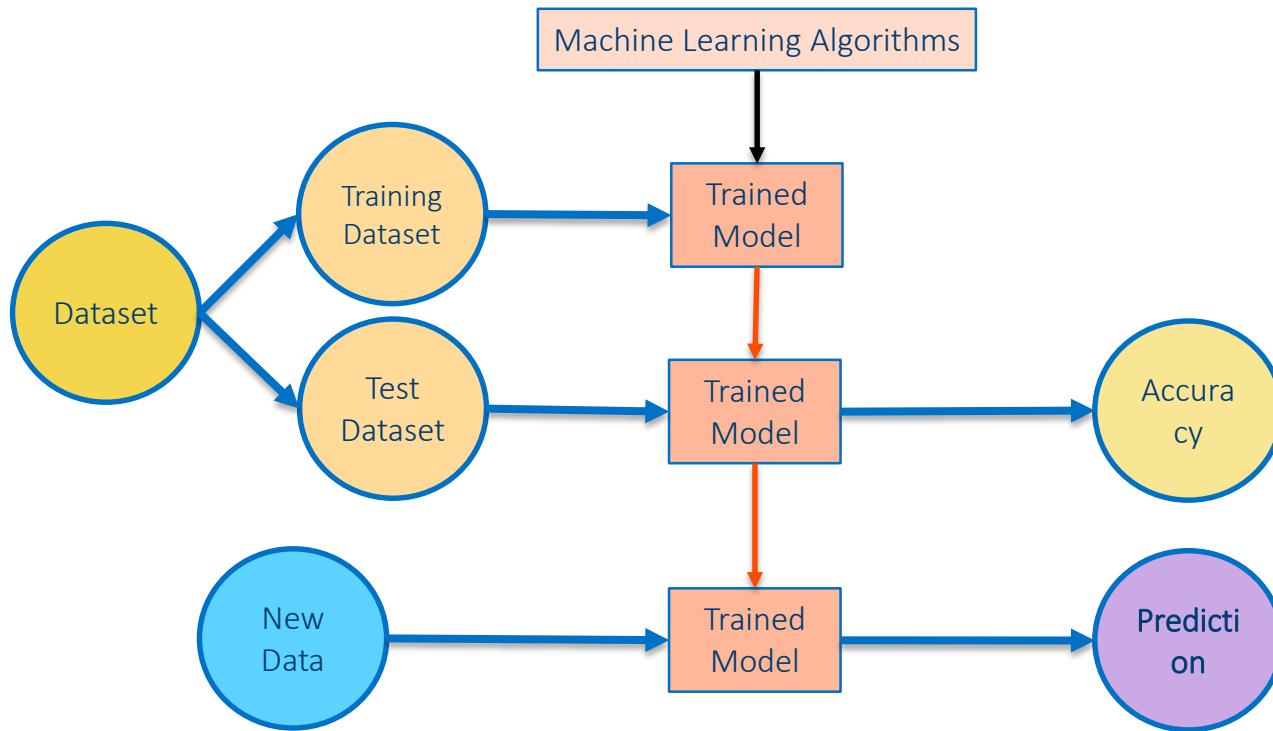
WHAT IS MACHINE LEARNING

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

Top
Frameworks



Programming
languages



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



TYPES OF MACHINE LEARNING

Types of Machine Learning

Supervised Learning

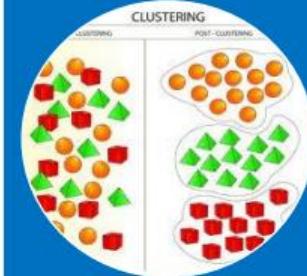
Teach desired behavior with labeled data



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”.

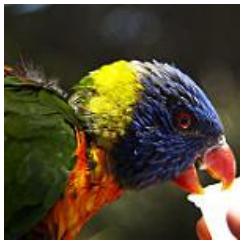
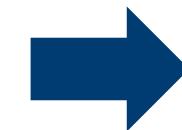
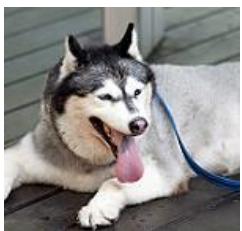
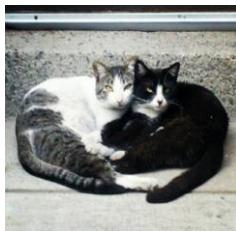
MACHINE LEARNING SOLUTIONS

CLASSIFICATION

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

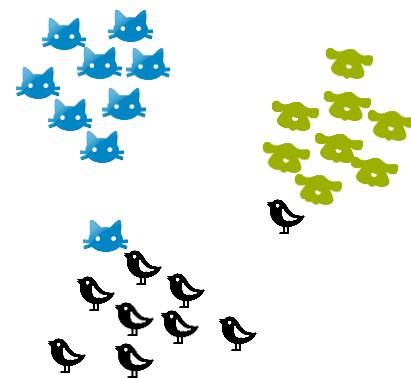
REGRESSION

CLASSIFICATION

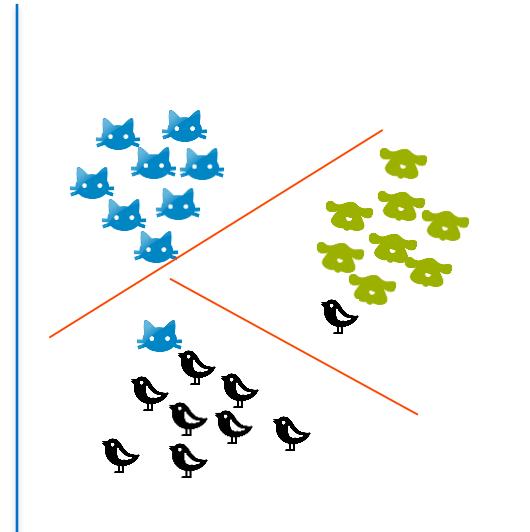


?

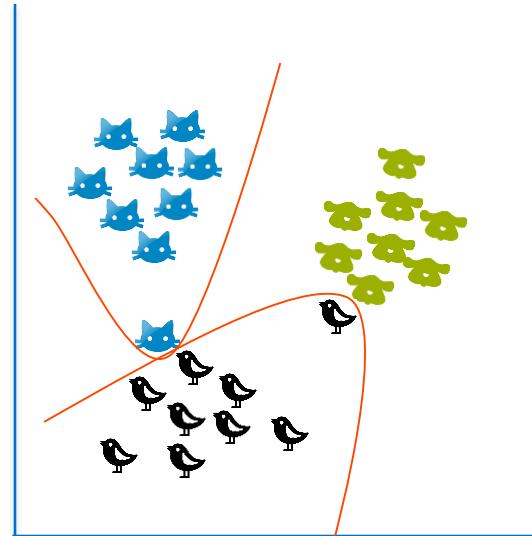
CLASSIFICATION



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  
chmod u+x Anaconda3-5.0.0.1-Linux-x86_64.sh  
./Anaconda3-5.0.0.1-Linux-x86_64.sh
```

Available at
<http://bit.ly/ai-workshop>

Install Required Packages

```
conda update conda
```

```
conda config --add channels intel
```

```
conda create -n workshop intelpython3_core python=3.6
```



Available at
<http://bit.ly/ai-workshop>

```
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/>



Available at
<http://bit.ly/ai-workshop>



HANDS-ON WORK

Case Study: Iris Dataset

CASE STUDY: IRIS PLANTS

Iris Dataset:

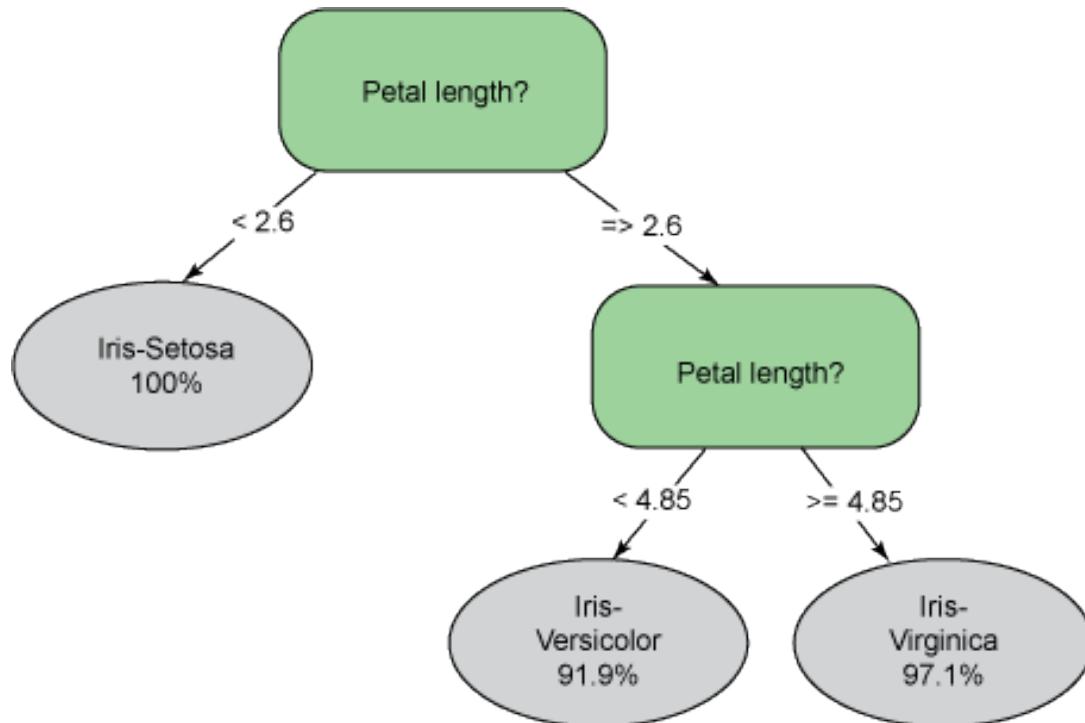
The data set contains 3 classes of 50 instances each, where each class refers to a type of iris plant. One class is linearly separable from the other 2; the latter are NOT linearly separable from each other.

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)

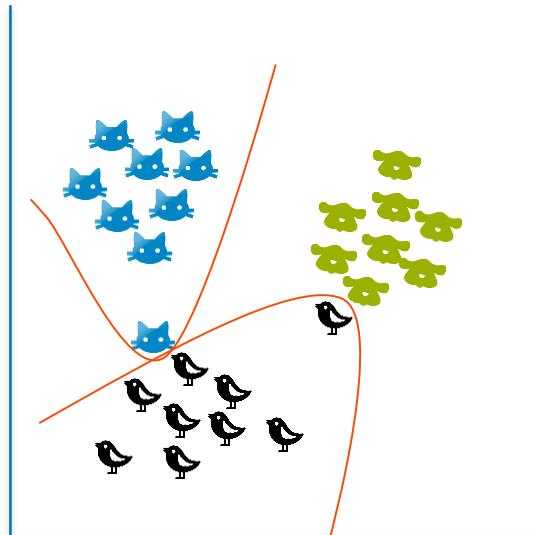
Target: Iris-Setosa, Iris-Versicolour, Iris-Virginica

DECISION TREES

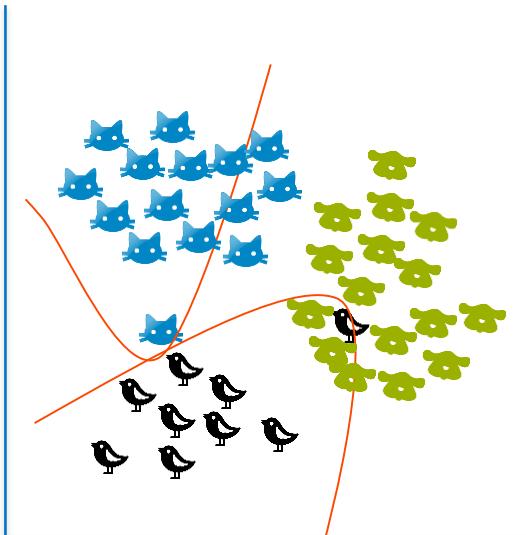


OVERFITTING

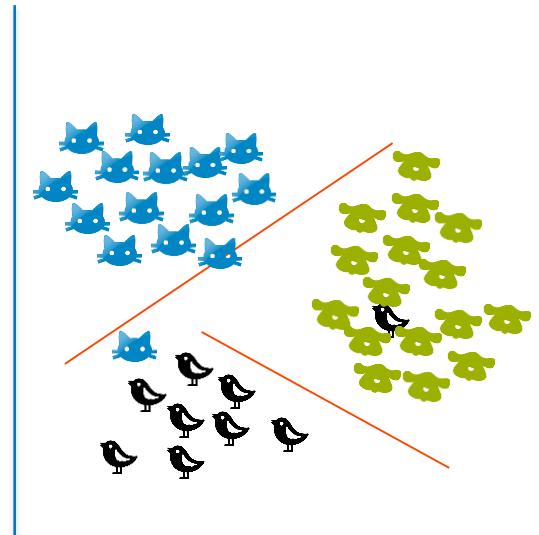
TRAINNING



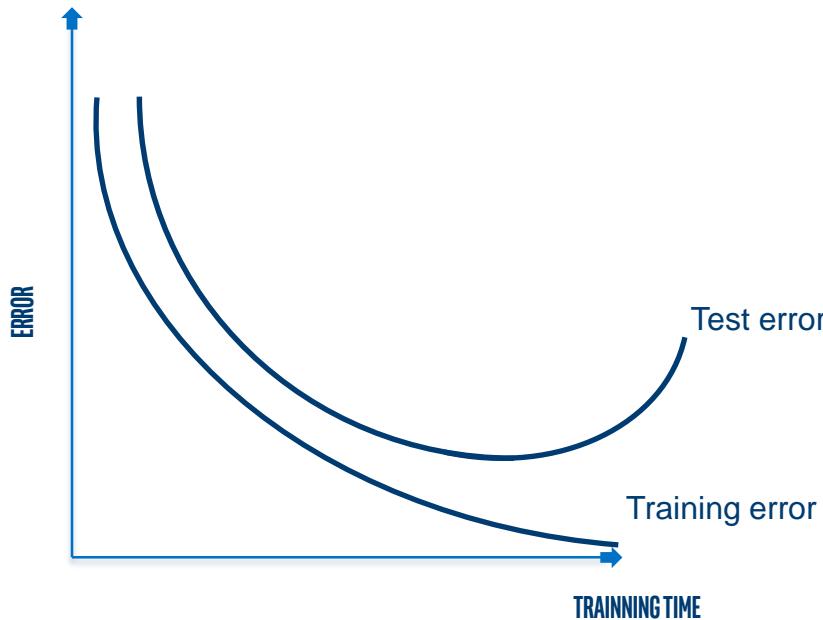
TESTING



TESTING



OVERFITTING

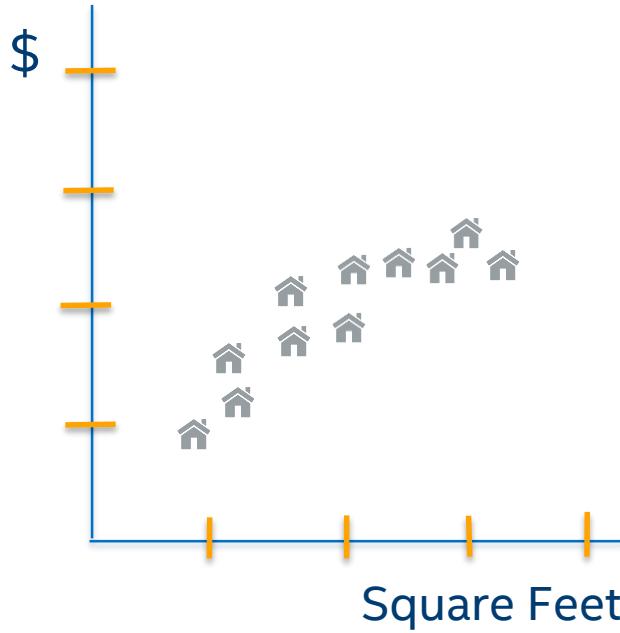


SUPERVISED LEARNING

CLASSIFICATION

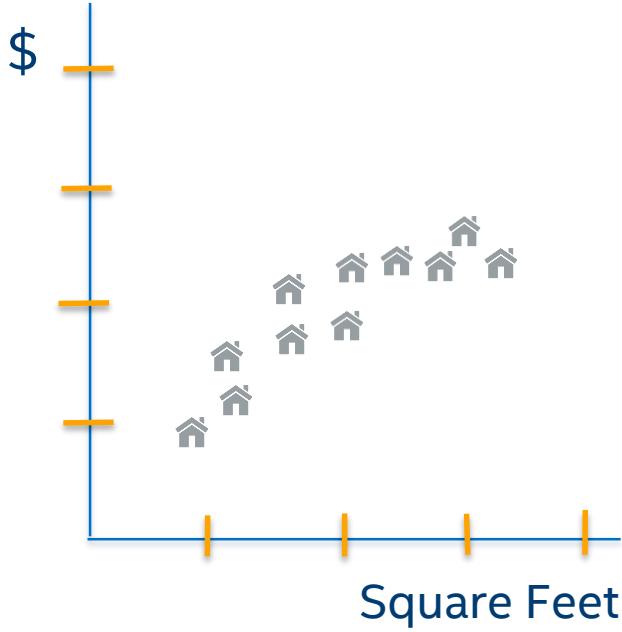
REGRESSION

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

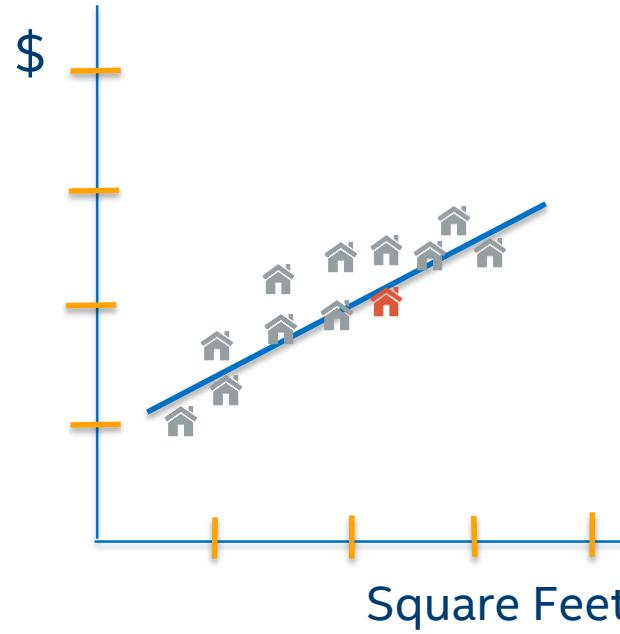


Set of Input vectors having a class or label

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

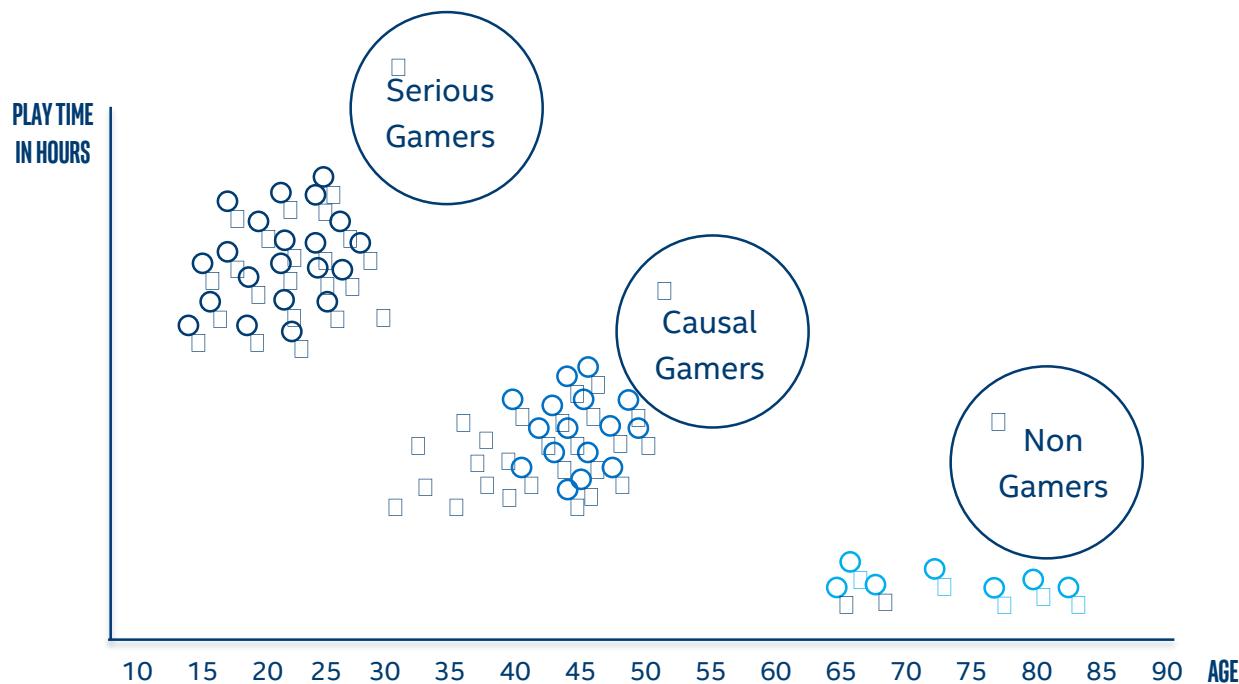
**DATA IS GIVEN TO THE MODEL. RIGHT ANSWERS ARE NOT PROVIDED TO THE MODEL.
THE MODEL MAKES SENSE OF THE DATA GIVEN TO IT.**

UNSUPERVISED LEARNING

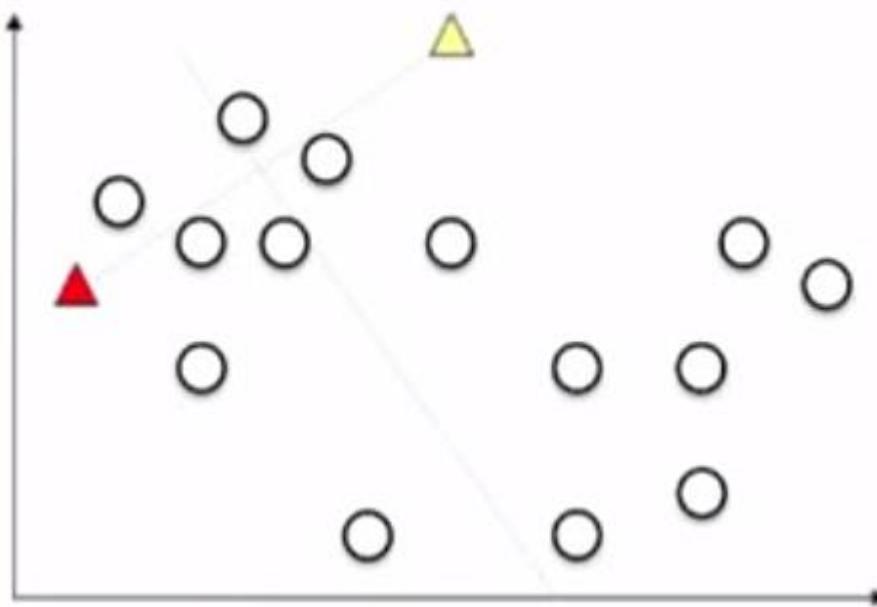
CLUSTERING

Grouping entities with similar features.
Unsupervised learning.

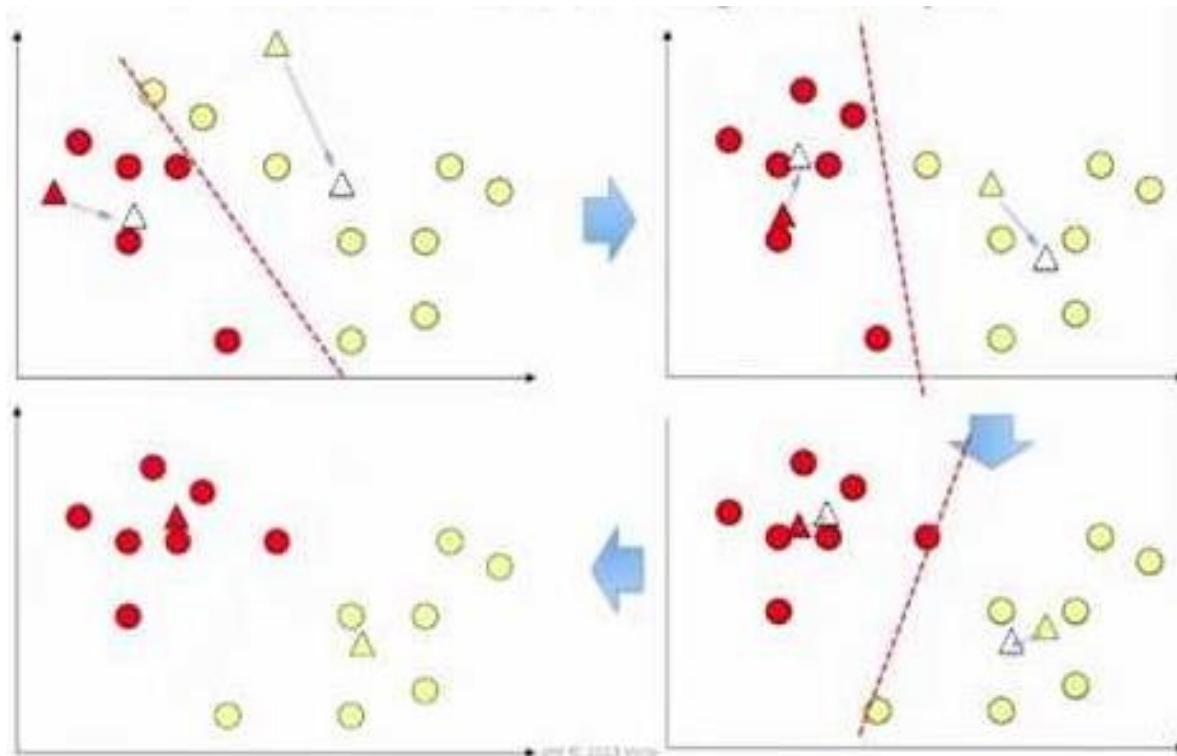
CLUSTERING EXAMPLE: MARKET SEGMENTATION



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>

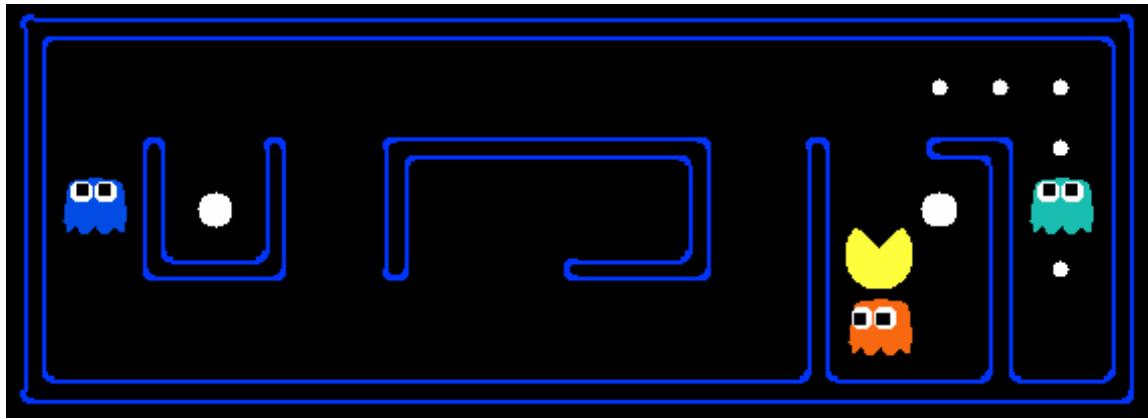
https://github.com/mstfldmr/IntelAIWorkshop/blob/master/KMeansClustering_2.ipynb

REINFORCEMENT LEARNING

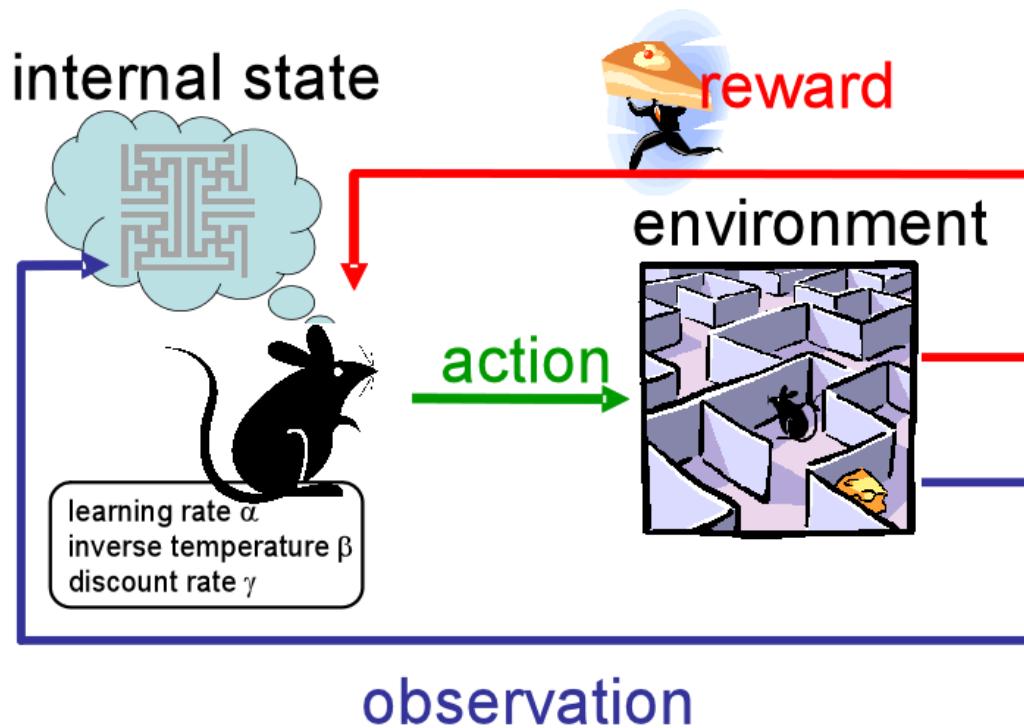
REINFORCEMENT LEARNING IS THE PROBLEM OF GETTING AN AGENT TO ACT IN THE WORLD SO AS TO MAXIMIZE ITS REWARDS.

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, Natural 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

Natural Language Processing, text
classification; web search, spam,
email filtering

CLASSIFICATION

-> Label the image

Person

Motorcyclist

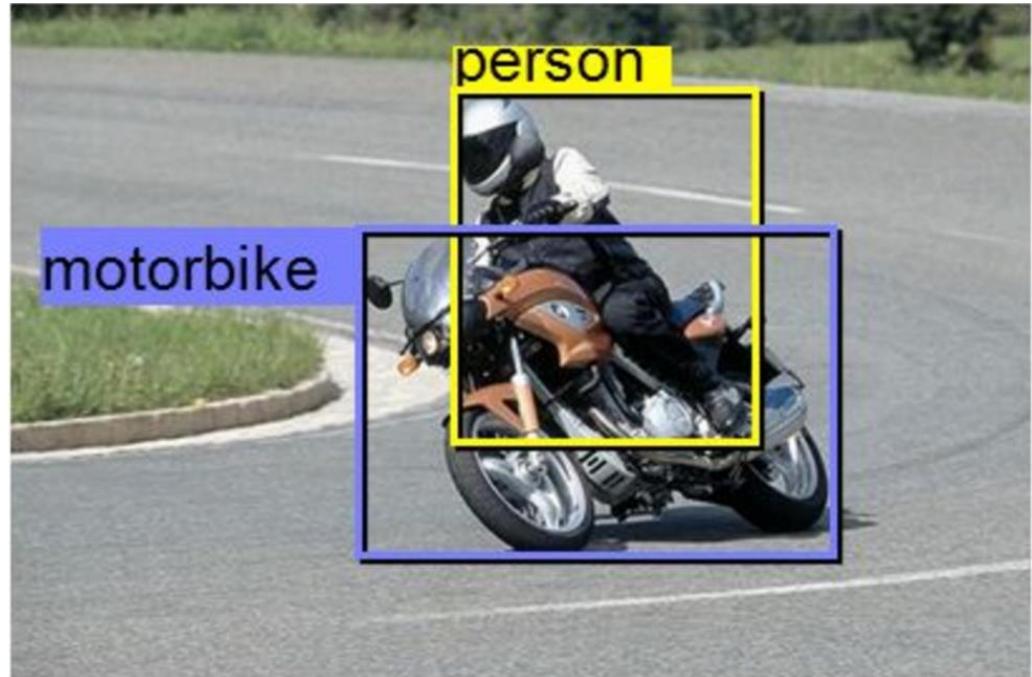
Bike



<https://people.eecs.berkeley.edu/~jhoffman/talks/llda-baylearn2014.pdf>

DETECTION

-> Detect and label



<https://people.eecs.berkeley.edu/~jhoffman/talks/llda-baylearn2014.pdf>

SEMANTIC SEGMENTATION

-> Label every pixel



<https://people.eecs.berkeley.edu/~jhoffman/talks/llda-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

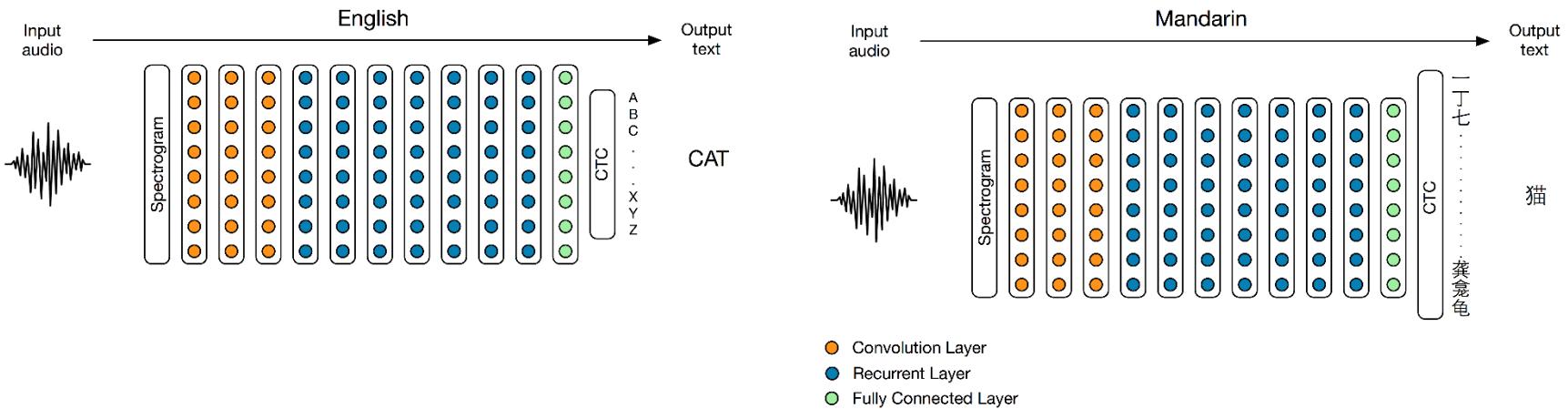
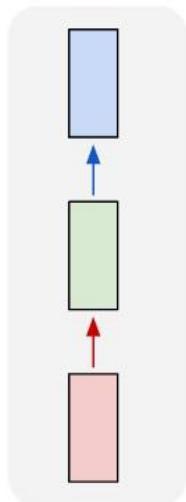


IMAGE / VIDEO CAPTIONING

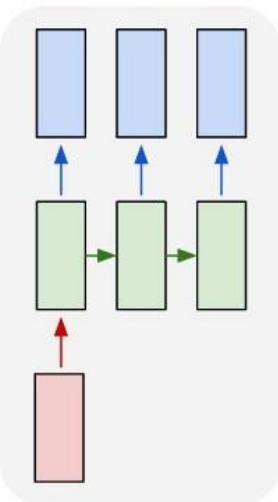
Describes without errors	Describes with minor errors	Somewhat related to the image
 A person riding a motorcycle on a dirt road.	 Two dogs play in the grass.	 A skateboarder does a trick on a ramp.
 A group of young people playing a game of frisbee.	 Two hockey players are fighting over the puck.	 A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

RECURRENT NEURAL NETWORKS

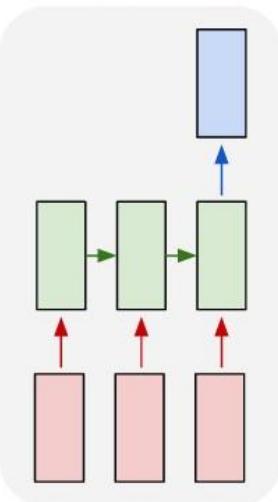
one to one



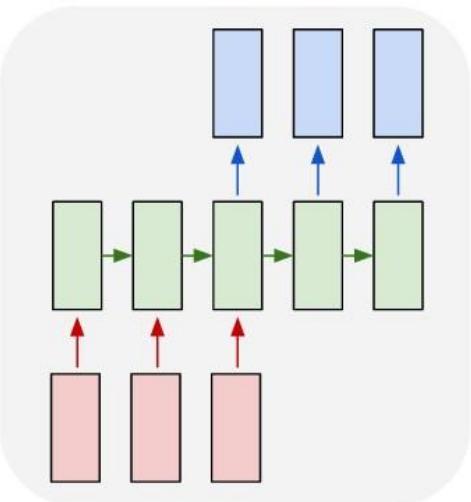
one to many



many to one



many to many



many to many

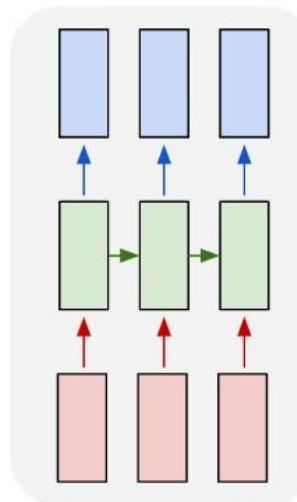


Image
Classification

Image
Captioning

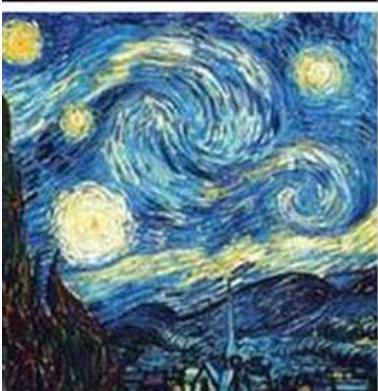
Sentiment
Analysis

Google Translate

Video Frame
Classification

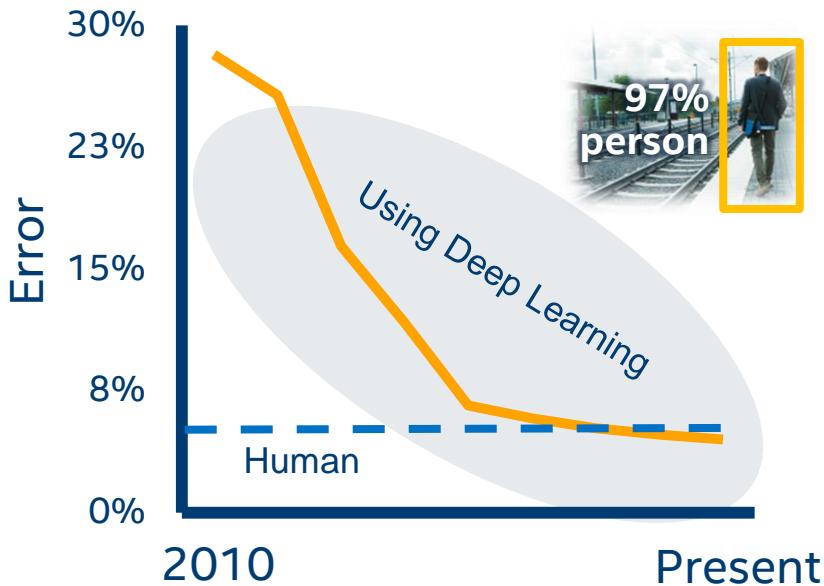
Red: input; Blue: output, Green: RNN state

GENERATIVE ADVERSARIAL NETWORKS

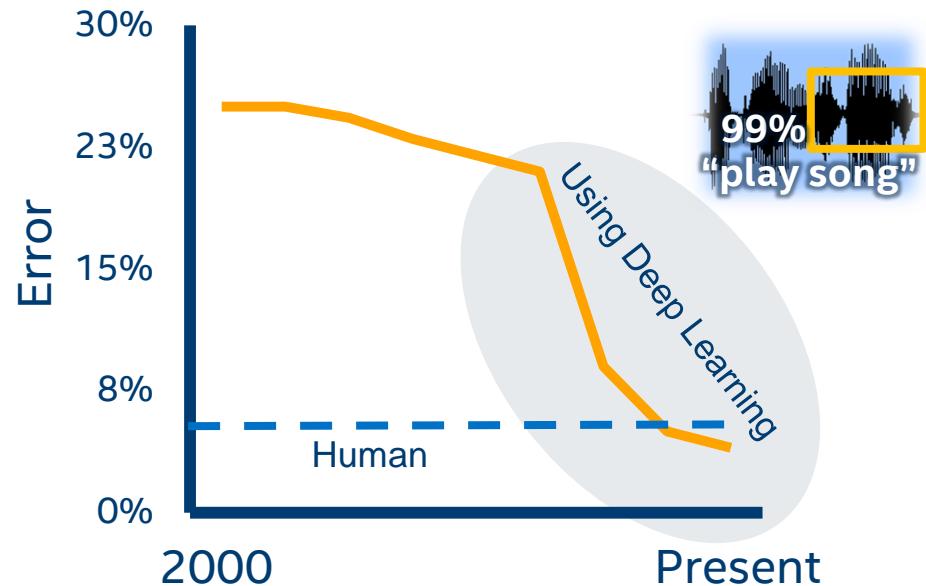


DEEP LEARNING BREAKTHROUGHS

IMAGE RECOGNITION



SPEECH RECOGNITION

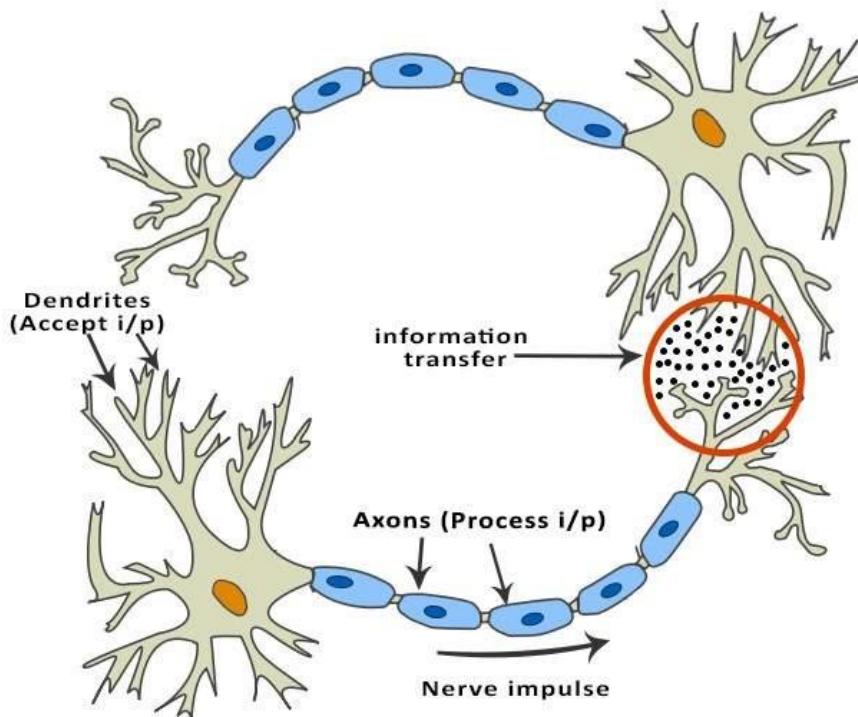


These and more are enabling new & improved applications



WHAT IS DEEP LEARNING

INSPIRED BY HUMAN BRAIN



CASE STUDY: RECOMMENDATION SYSTEMS

A screenshot of the Netflix homepage. At the top, there's a navigation bar with the Netflix logo, a "Browse" dropdown, a "DVD" link, a search bar with a magnifying glass icon, a notification bell icon with a "1" notification, and a user profile for "Mr. Wadhwa". Below the navigation is a banner with five TV show thumbnails: "SHERLOCK", "THE X-FILES", "THE RETURNED", "NURSE JACKIE", and "UNBREAKABLE KIMMY SCHMIDT". Underneath this banner, there's a section titled "TV Shows" with five more thumbnails: "LOVE", "BETTER CALL SAUL", "COOKED", "BATES MOTEL", and "HIGHWAY THRU HELL".

NETFLIX

Browse ▾ DVD

Continue Watching for Mr. Wadhwa

Search

1

Mr. Wadhwa ▾

SHERLOCK

THE X-FILES

THE RETURNED

NEW EPISODES

NURSE JACKIE

UNBREAKABLE KIMMY SCHMIDT

TV Shows

NETFLIX LOVE

BETTER CALL SAUL

COOKED

BATES MOTEL

NEW EPISODES

HIGHWAY THRU HELL

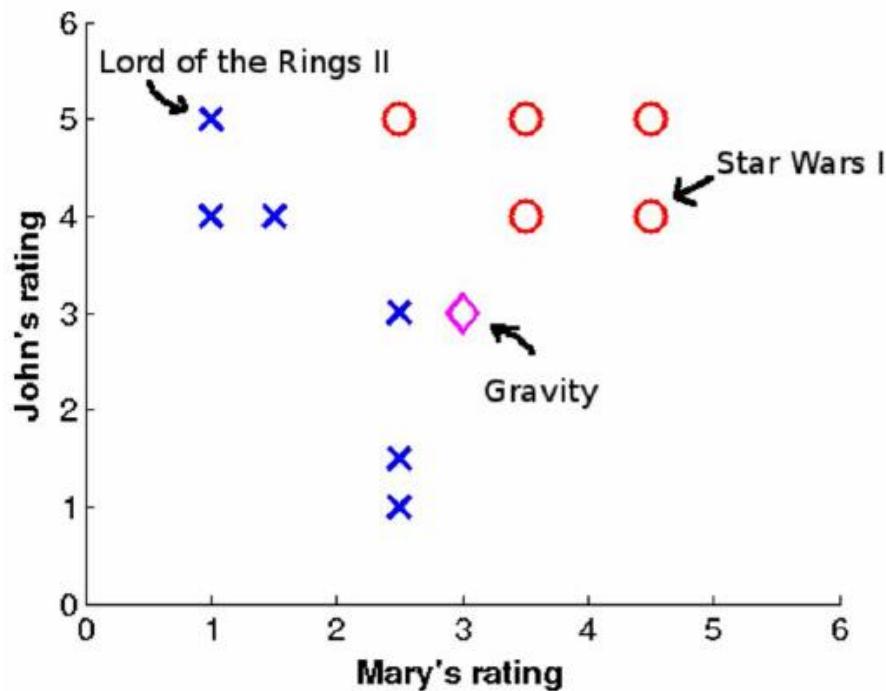


Will Nancy like Gravity?

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	?



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

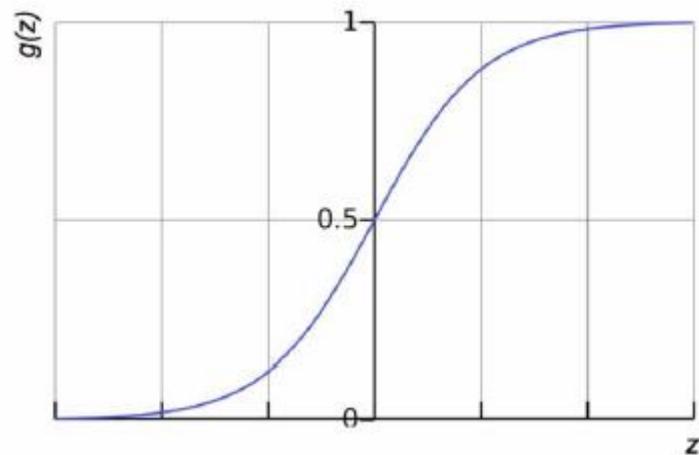
ACTIVATION FUNCTION

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.

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

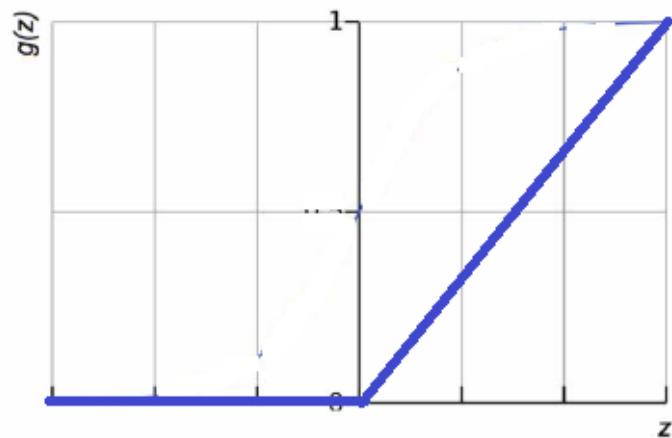


ACTIVATION FUNCTION

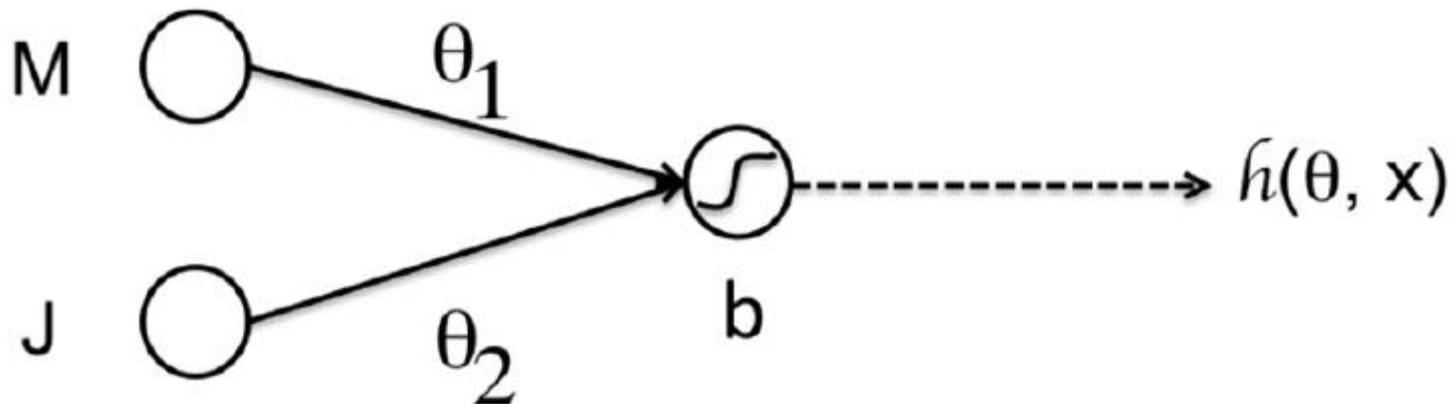
This function has a problem. Its values are unbounded.
We want its output to be in the range of 0 and 1.

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.

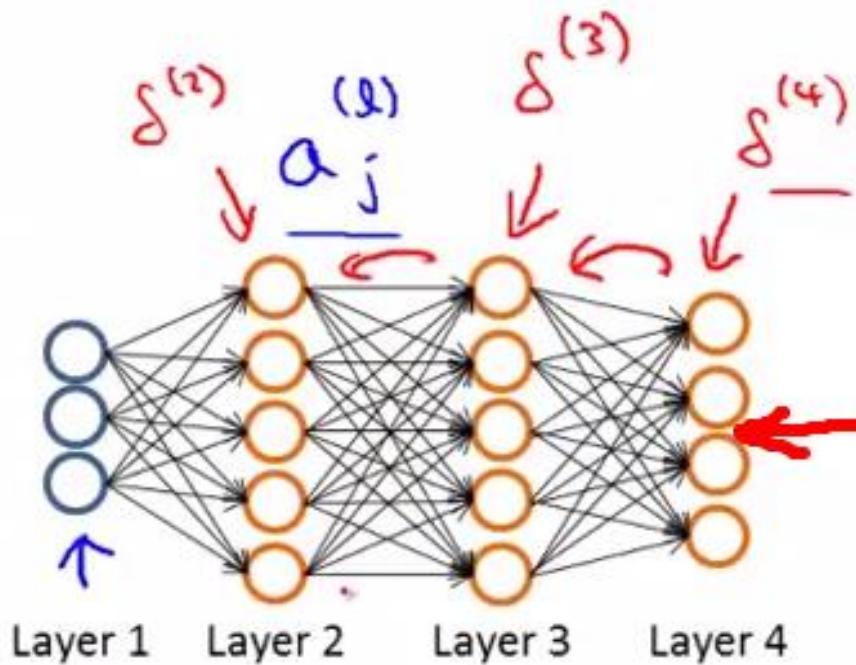
COST FUNCTION

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

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

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

BACKPROPOGATION



STOCHASTIC GRADIENT DESCENT

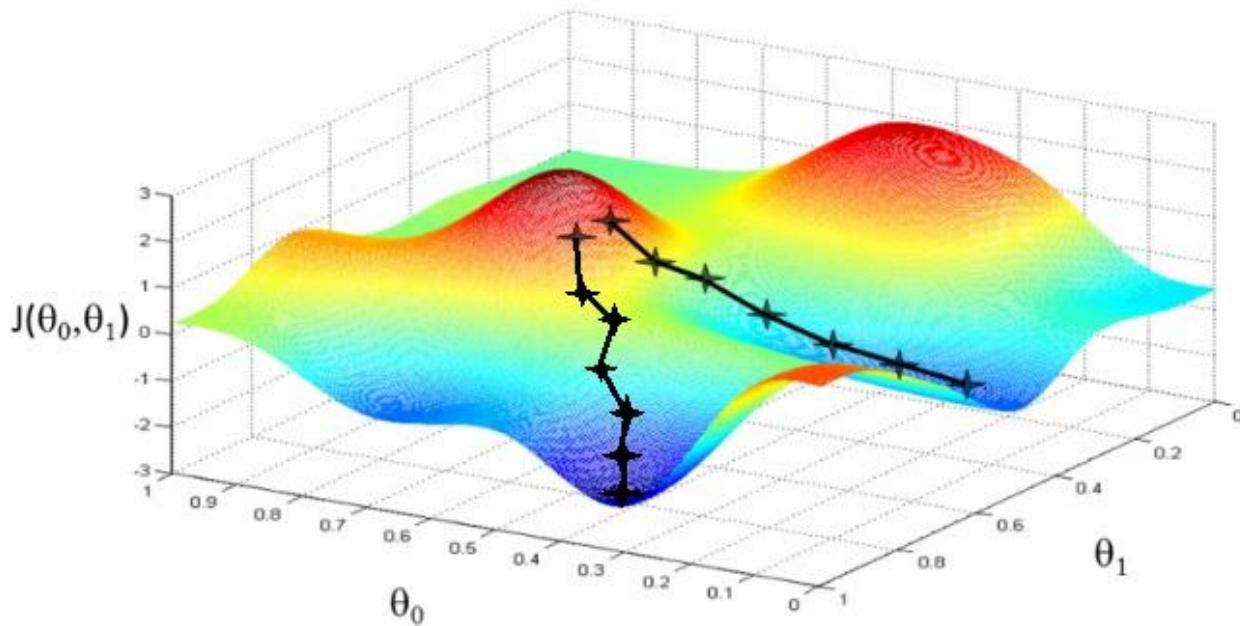
Use Stochastic Gradient Descent (SGD):

$$\theta_1 = \theta_1 - \alpha \Delta \theta_1$$

$$\theta_2 = \theta_2 - \alpha \Delta \theta_2$$

$$b = b - \alpha \Delta b$$

STOCHASTIC GRADIENT DESCENT



STEPS

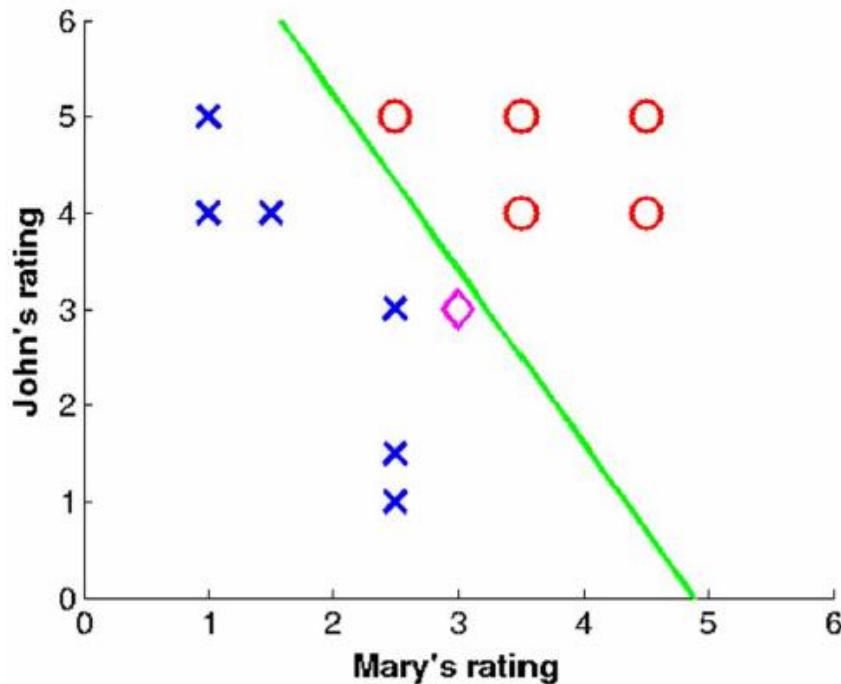
1. Initialize the parameters θ and b at random
2. Pick a random example $\{x^{(i)}, y^{(i)}\}$
3. Compute the partial derivatives of θ_1, θ_2, b
4. Update parameters using:

$$\theta_1 = \theta_1 - \alpha \Delta \theta_1$$

$$\theta_2 = \theta_2 - \alpha \Delta \theta_2$$

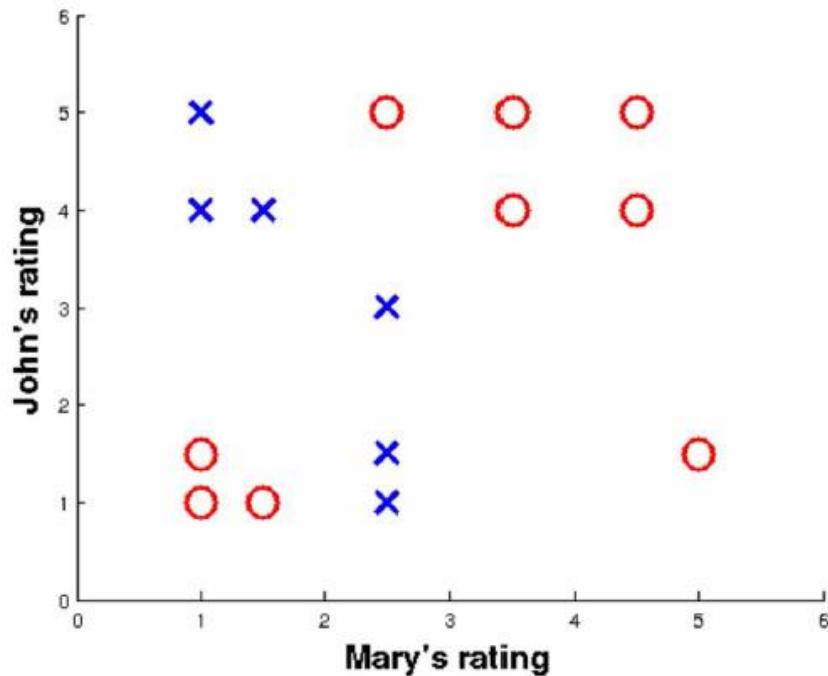
$$b = b - \alpha \Delta b$$

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



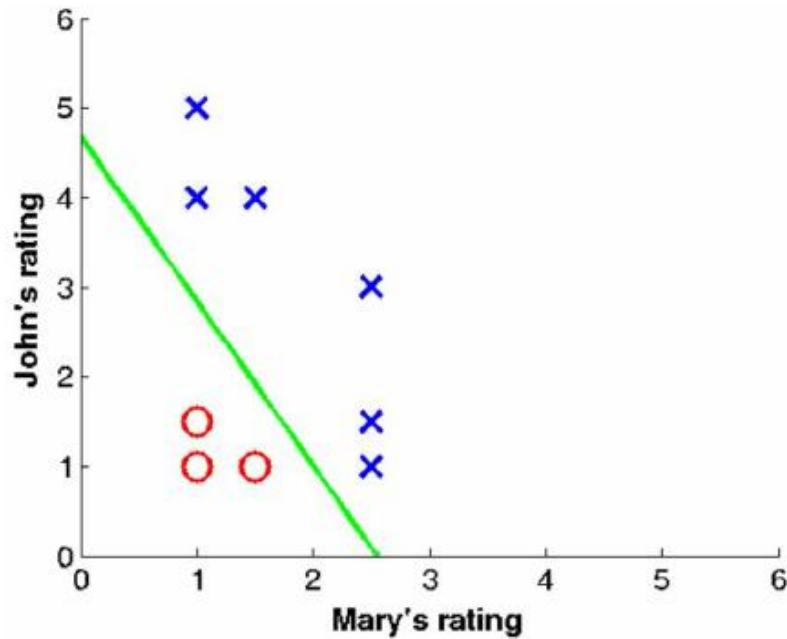
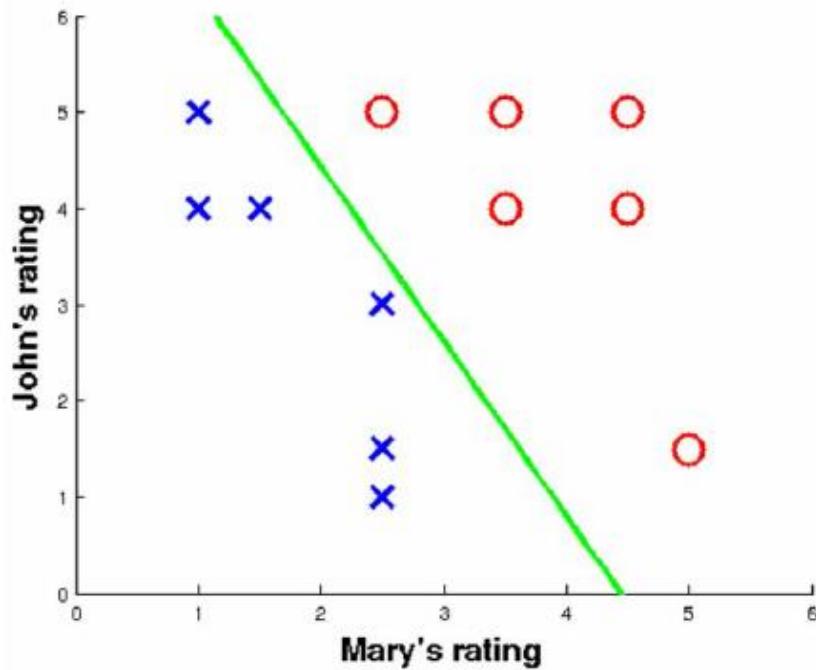
Gravity movie is slightly on the “don’t watch” side.

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



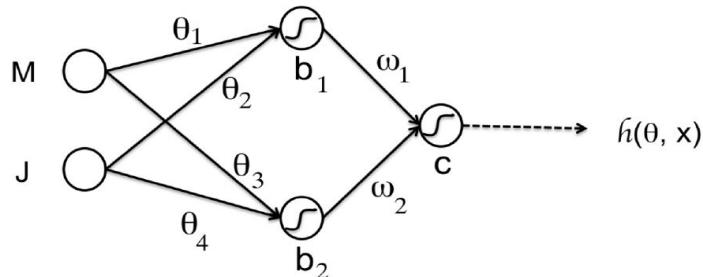
Nancy likes some of the movies both Mary and John rated poorly.

How can I have a linear decision boundary separate these?

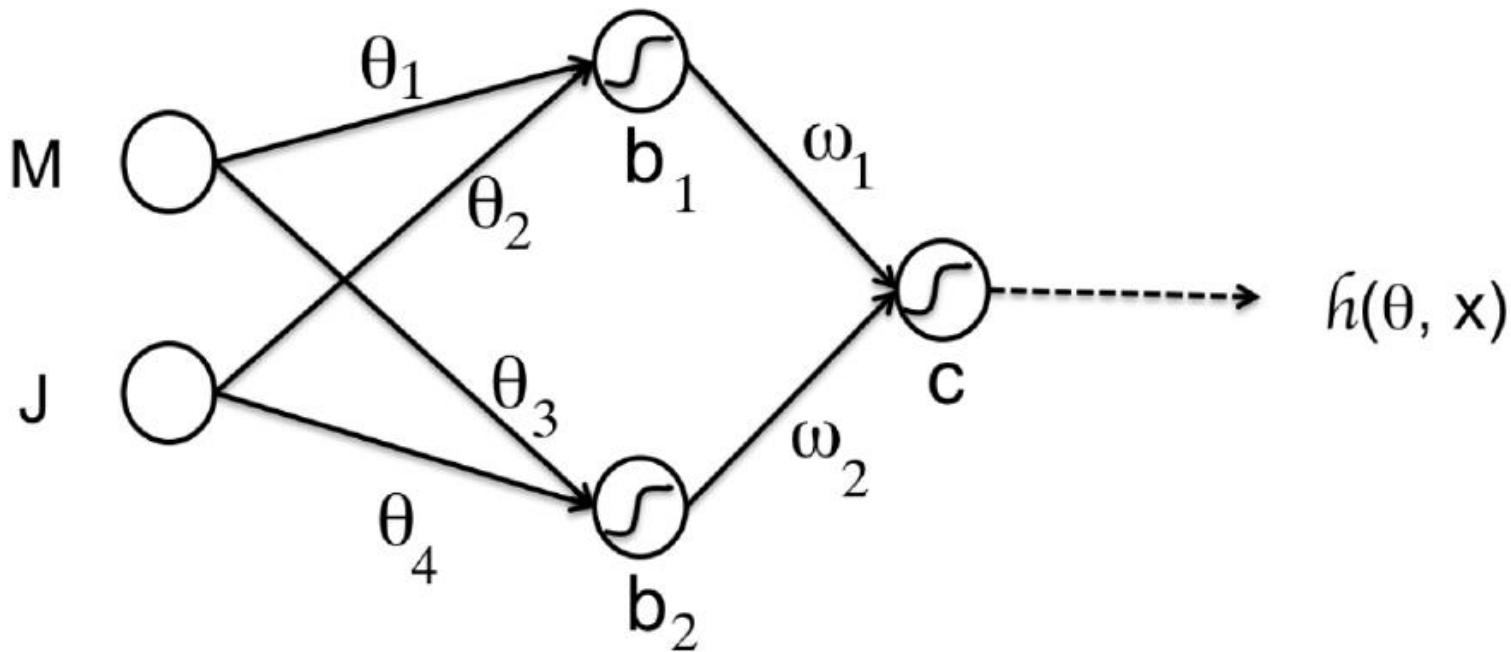




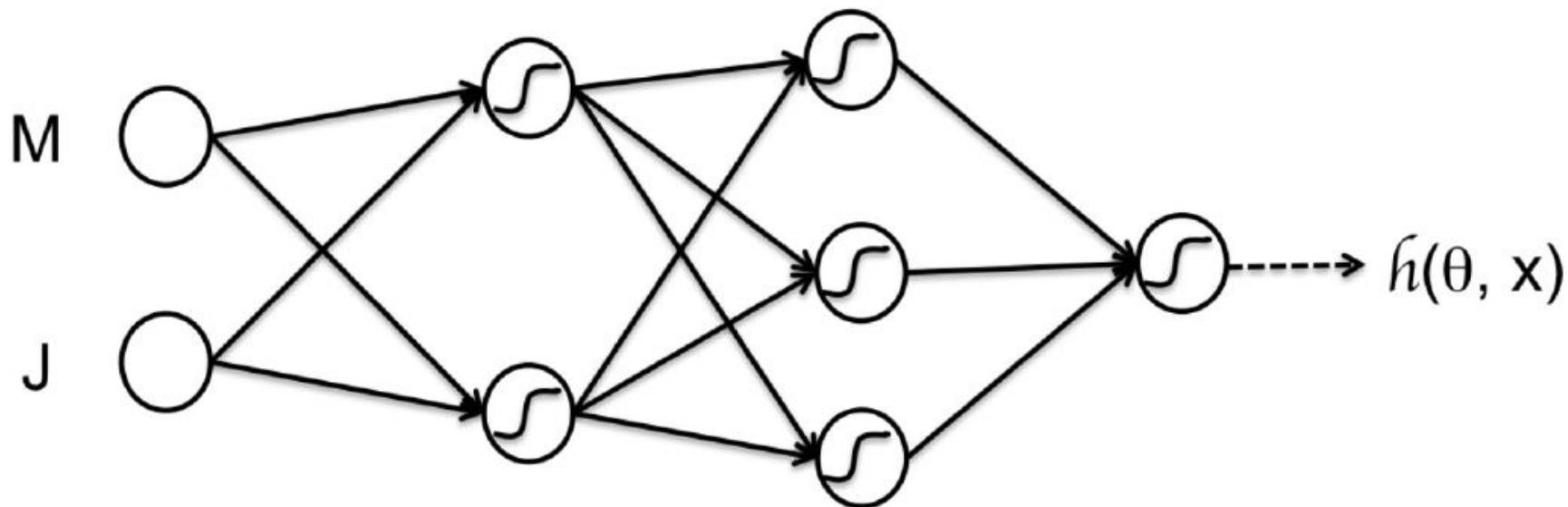
Movie	Output by decision function h_1	Output by decision function h_2	Does Nancy like?
Lord of the Rings 2	$h_1(x^{(1)})$	$h_2(x^{(1)})$	No
...
Star Wars 1	$h_1(x^{(n)})$	$h_2(x^{(n)})$	Yes
Gravity	$h_1(x^{(n+1)})$	$h_2(x^{(n+1)})$?



THIS IS THE NEURAL NETWORK

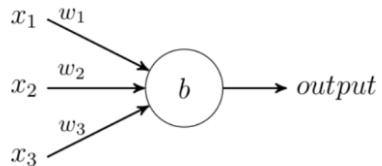


A DEEPER NEURAL NETWORK



DEEP LEARNING: BASIC STRUCTURE

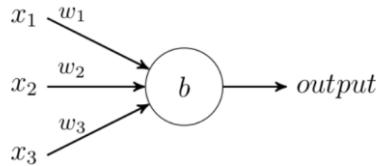
BASIC SINGLE NEURON



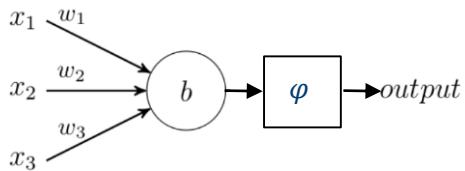
$$u_n = \sum_{j=1}^m w_{nj} x_j$$

DEEP LEARNING: BASIC STRUCTURE

BASIC SINGLE NEURON



SINGLE NEURON WITH ACTIVATION

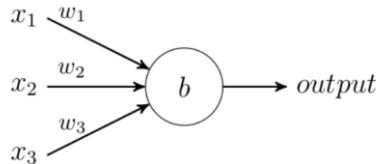


$$u_n = \sum_{j=1}^m w_{nj} x_j$$

φ → Activation
function

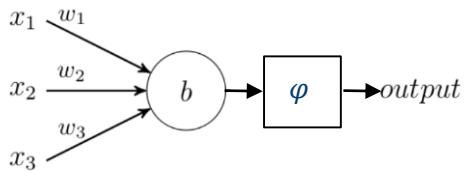
DEEP LEARNING: BASIC STRUCTURE

BASIC SINGLE NEURON



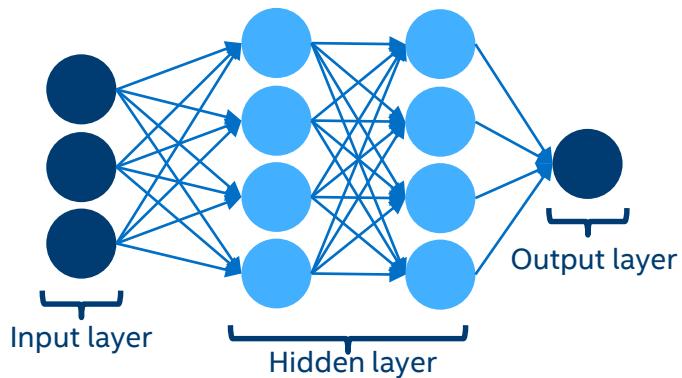
$$u_n = \sum_{j=1}^m w_{nj} x_j$$

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

Algorithms

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

Inference, Clustering, or Classification

Training Data*

New Data*

DEEP LEARNING

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



New Data
CNN, RNN, RBM...

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

*Note: not all classic machine learning functions require training



STUDENT DEVELOPER PROGRAM

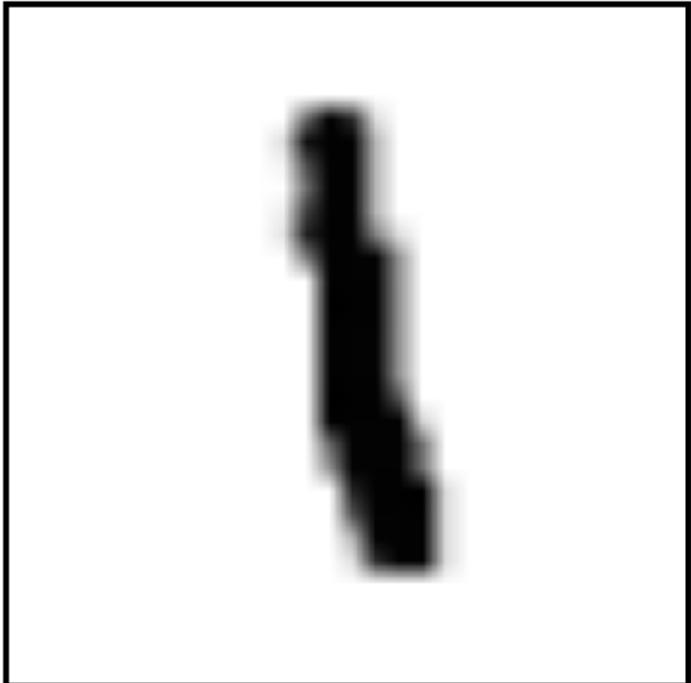


VANILLA NEURAL NETWORKS

USE CASE: HANDWRITTEN DIGITS (MNIST)



USE CASE: HANDWRITTEN DIGITS (MNIST)



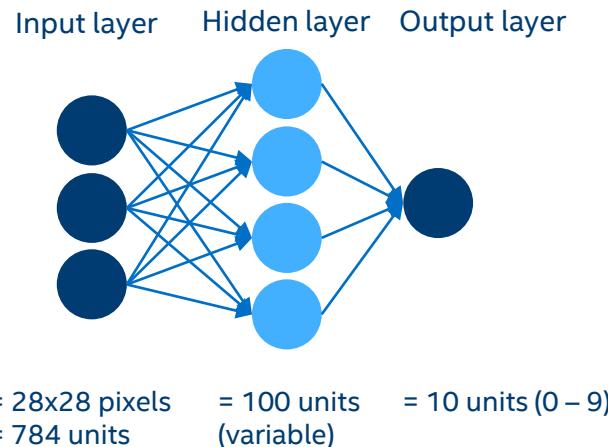
{

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	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	0	0	0	0	0	0	.7	1	0	0	0	0	0	0	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	0	0	0	0	0	0	.5	1	.4	0	0	0	0	0	0	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	0	0	0	0	0	0	1	.4	0	0	0	0	0	0	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	0	0	0	0	0	0	1	1	0	0	0	0	0	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	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

USE CASE: HANDWRITTEN DIGITS (MNIST)

3421956218
8912500664
6701636370
3779466182
2934398725
1598365723
9319158084
5626858899
3770948543
7964706923

MNIST DATASET 28x28 Pixels



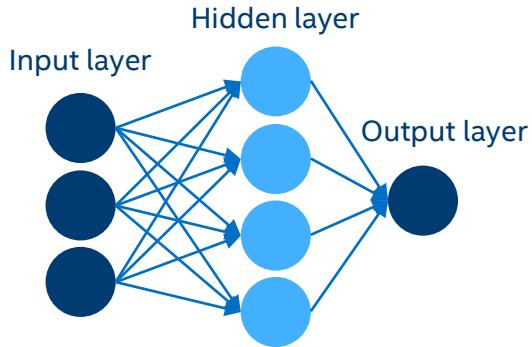
TOTAL PARAMETERS

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

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

TRAINING

3



- 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.

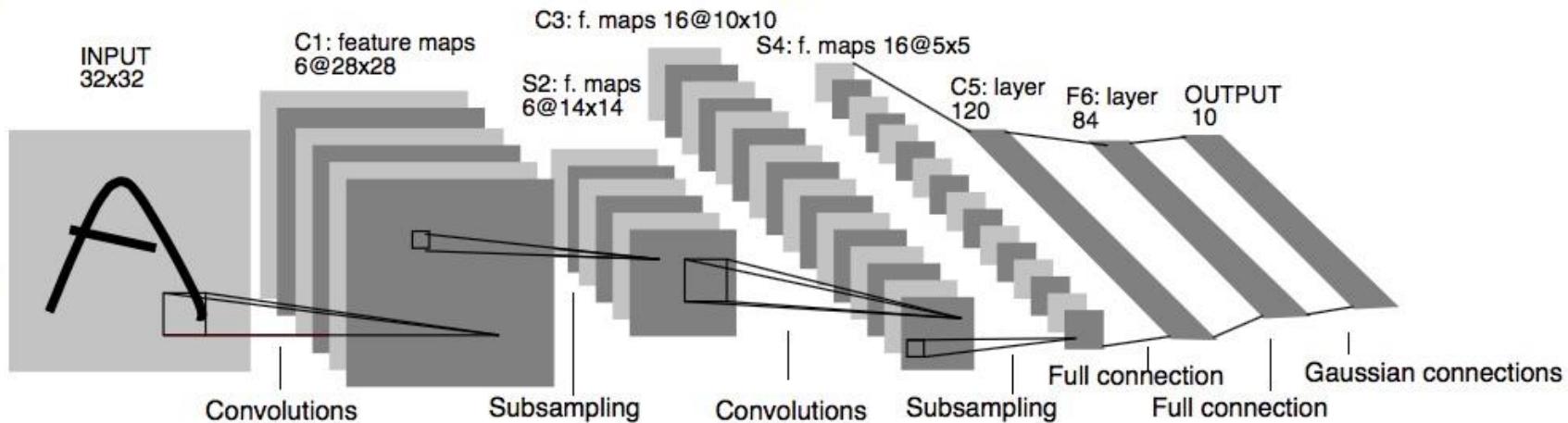
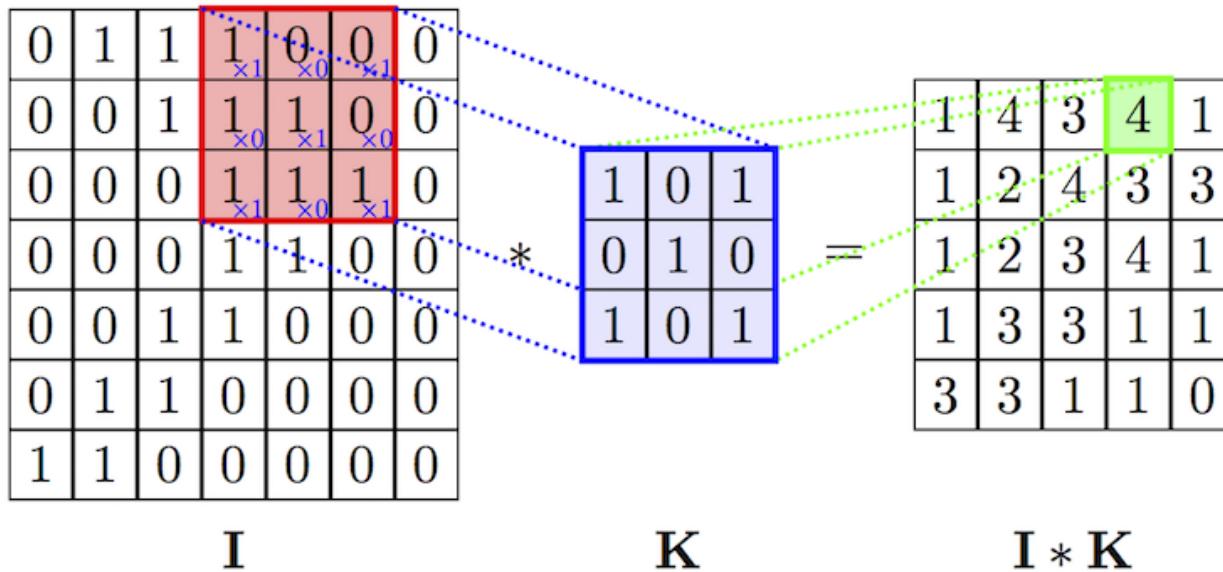


Fig. 2. Architecture of LeNet-5, a Convolutional Neural Network, here for digits recognition. Each plane is a feature map, i.e. a set of units whose weights are constrained to be identical.

CONVOLUTION



CONVOLUTION



*

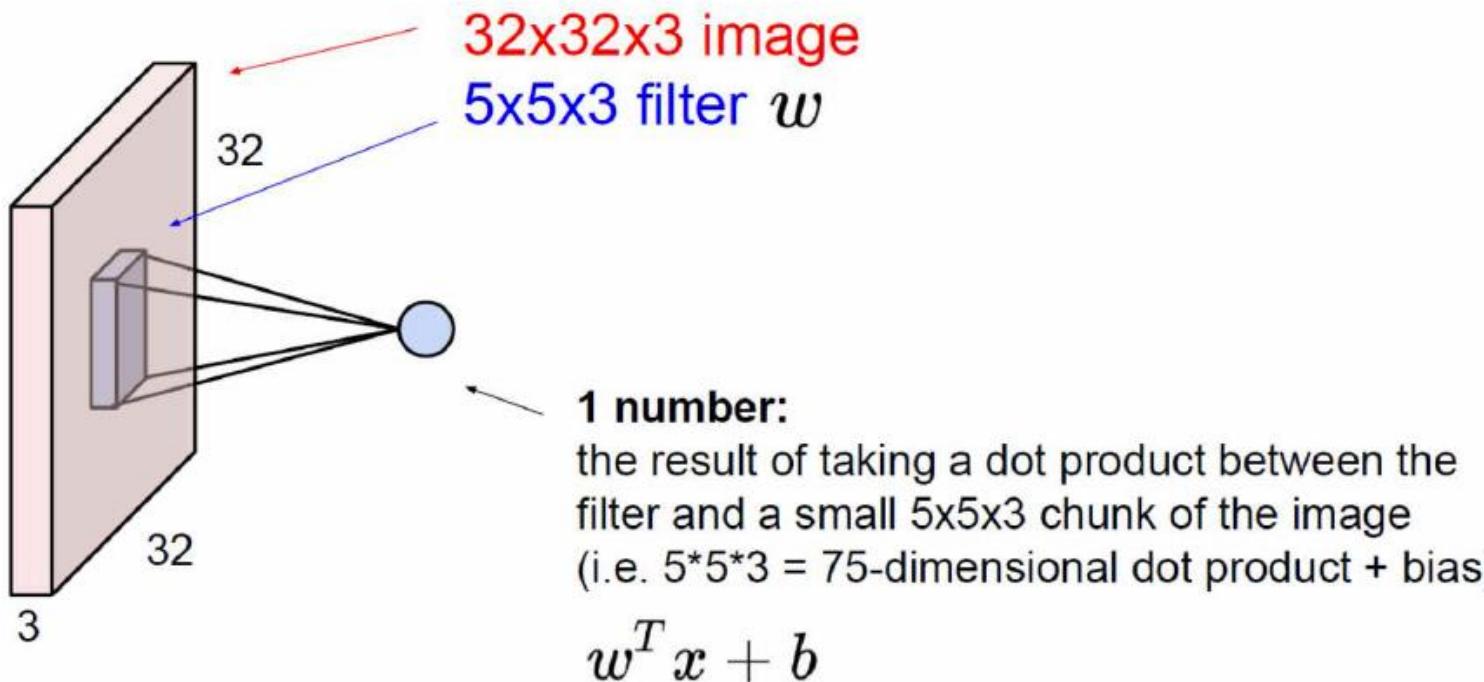
1	0	-1
2	0	-2
1	0	-1



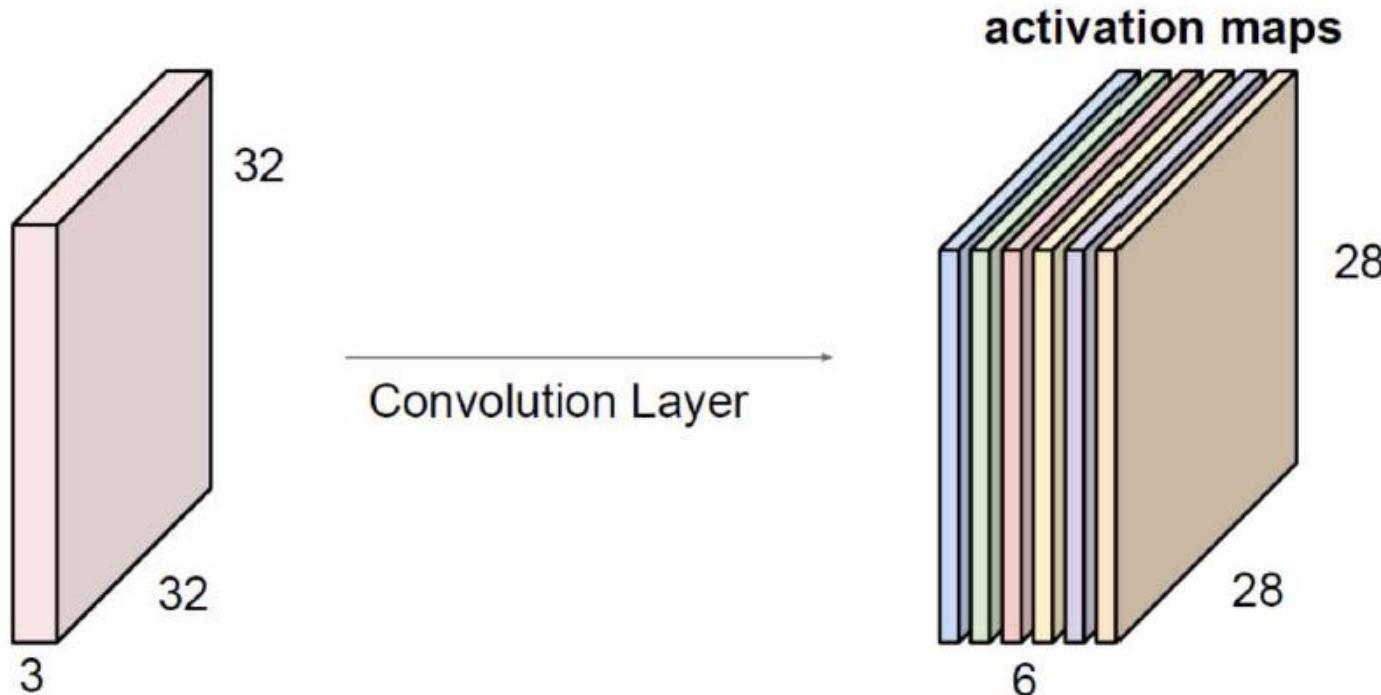
CONVOLUTION



Convolution Layer

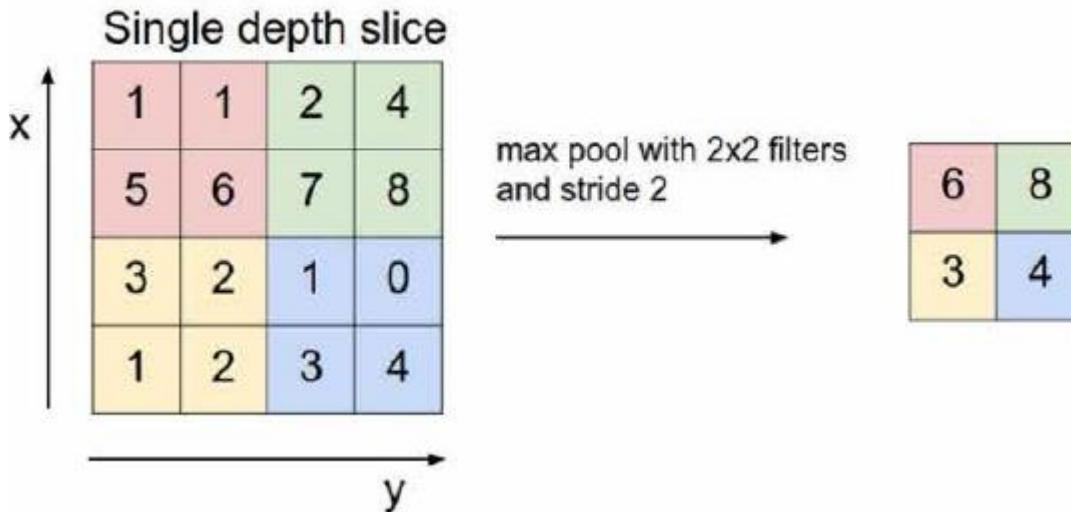


Convolution Layer

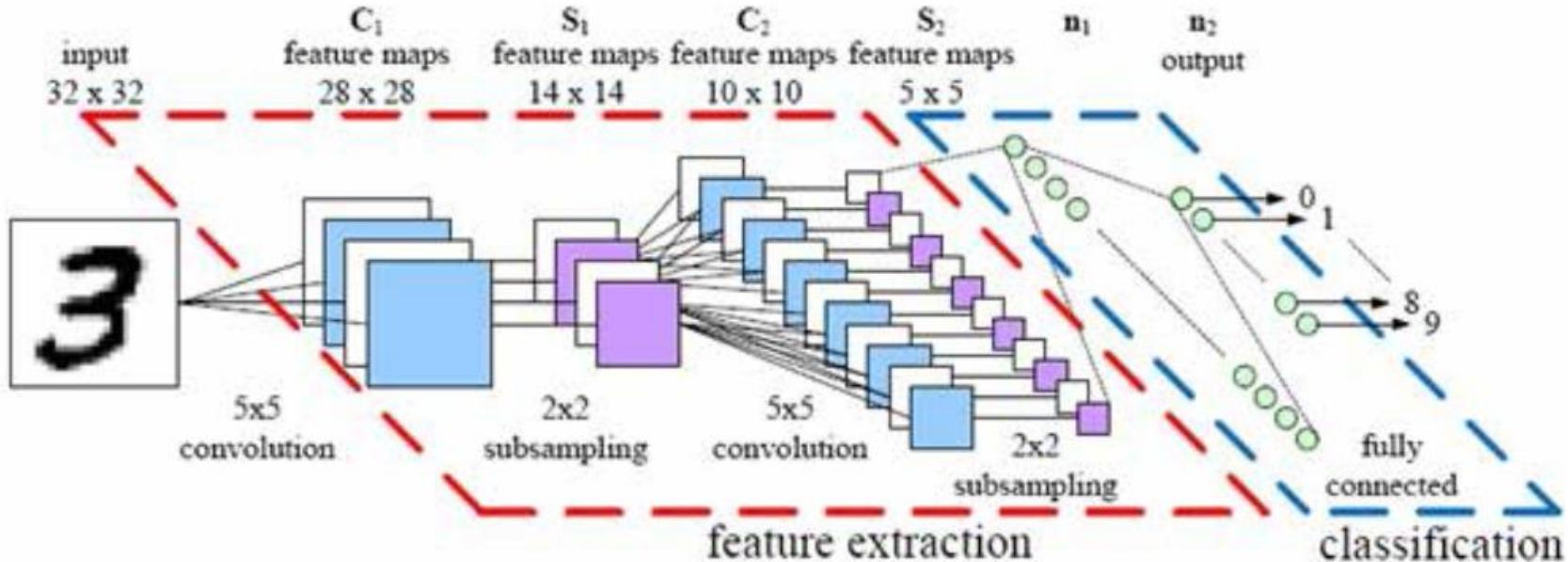


We stack these up to get a “new image” of size $28 \times 28 \times 6$!

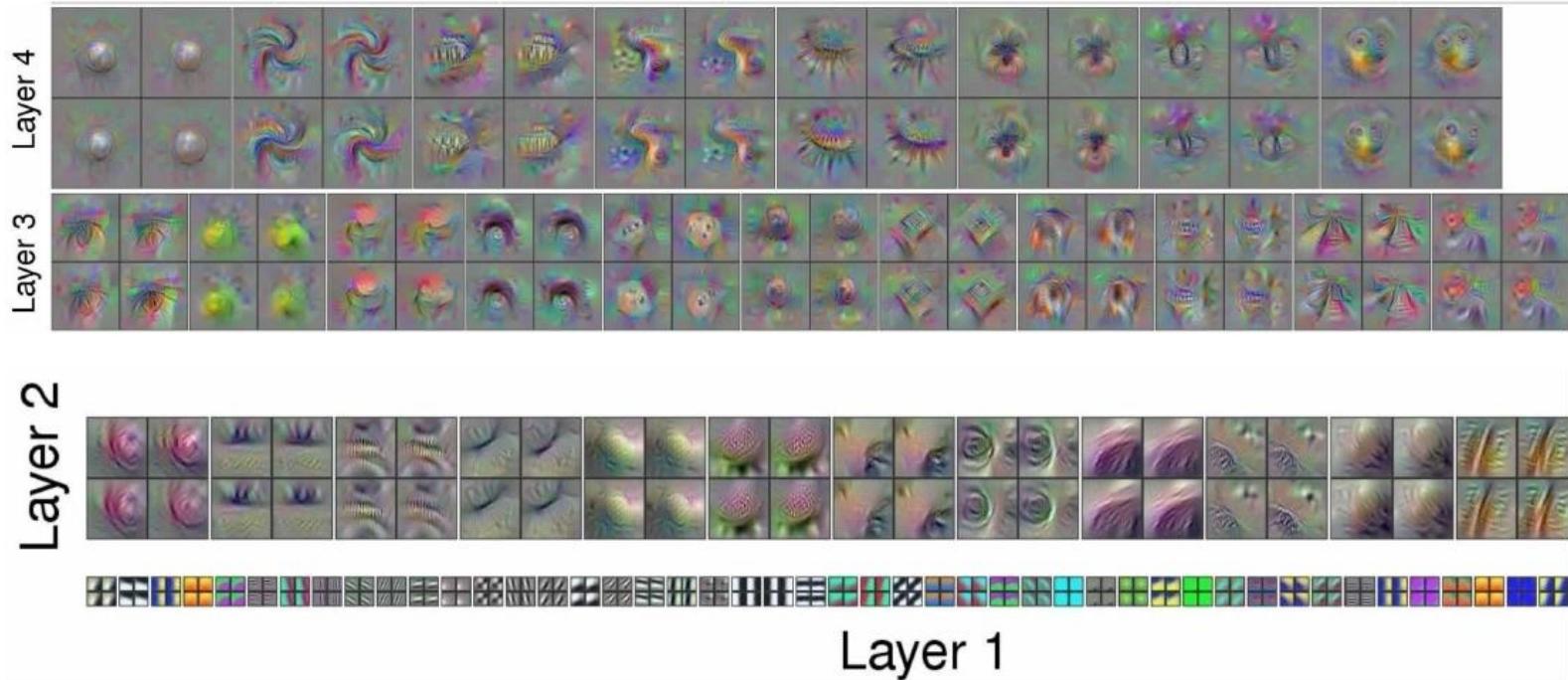
Max Pooling



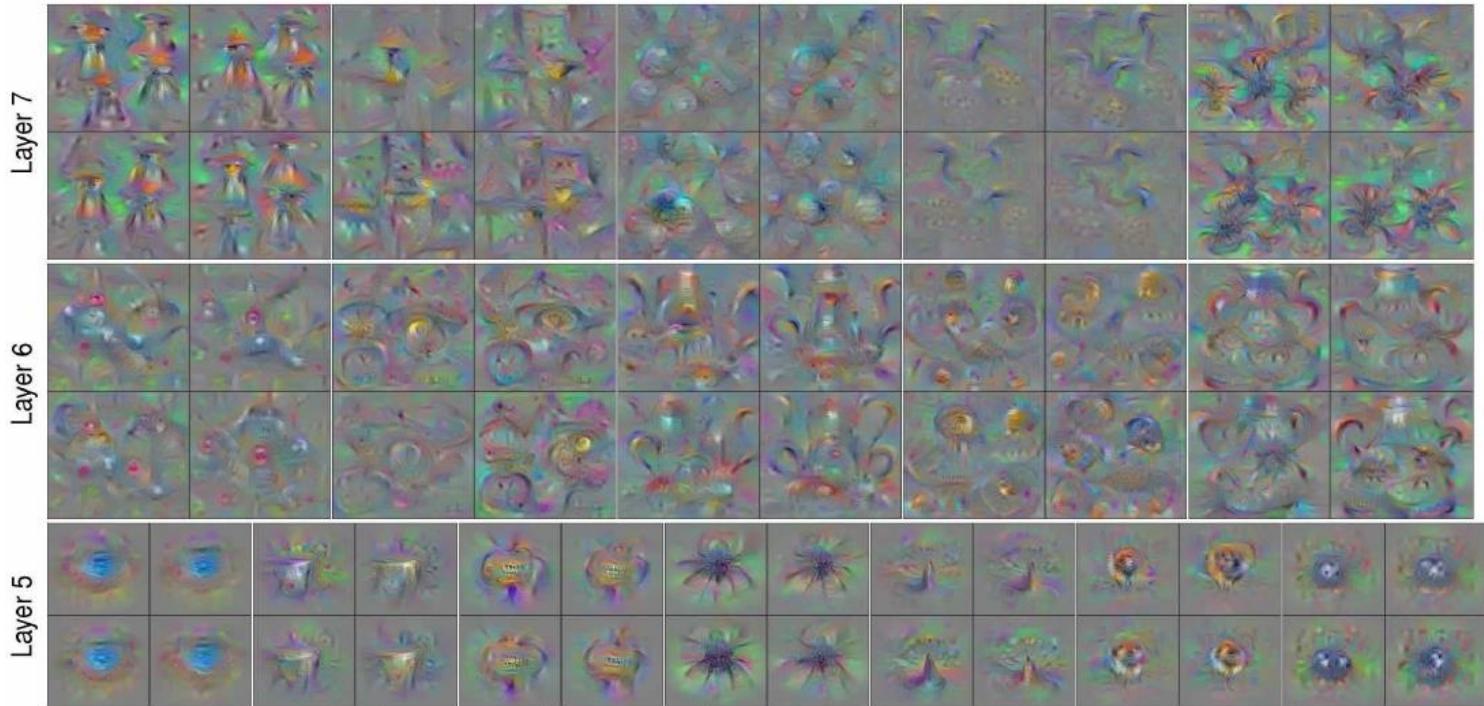
CNN Pipeline



Visualizing Neurons



Visualizing Neurons



Visualizing Neurons

Layer 8



Pirate Ship

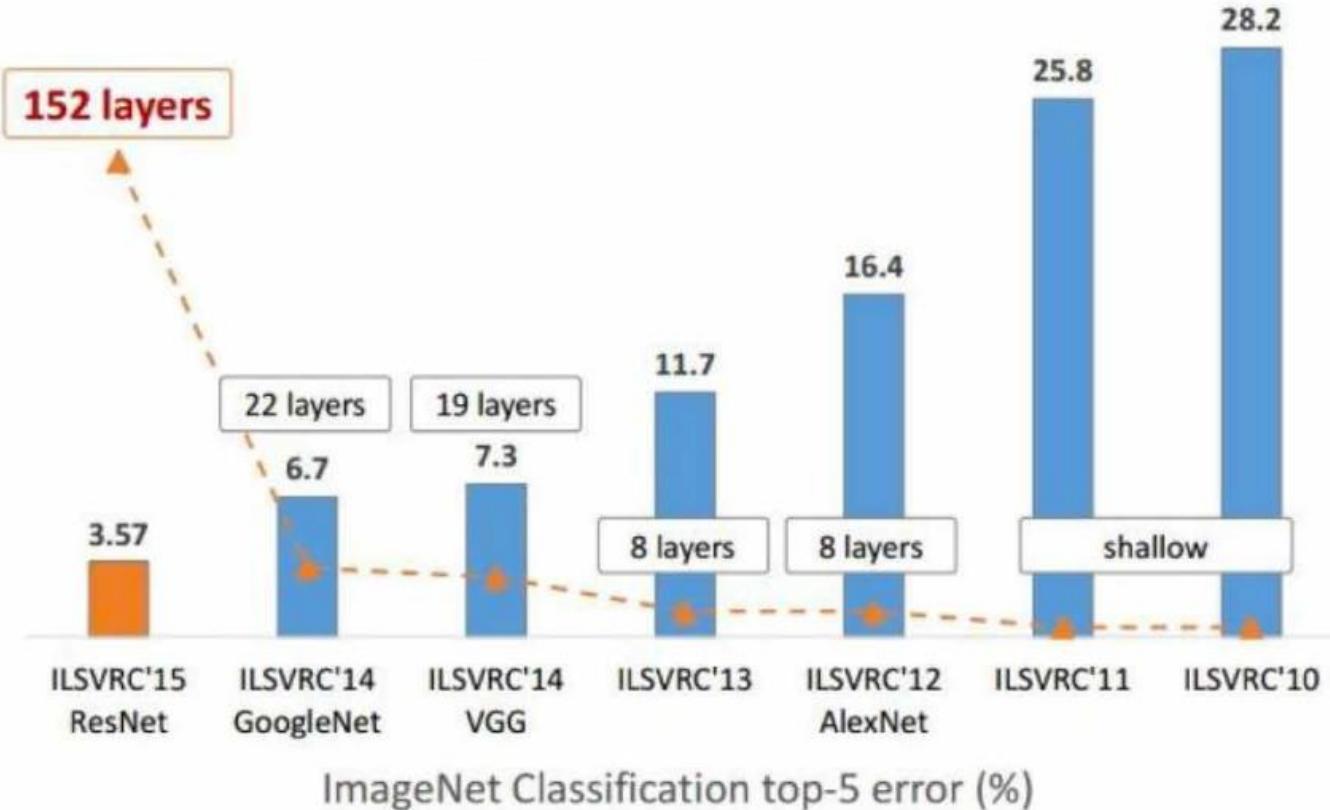
Rocking Chair

Teddy Bear

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.

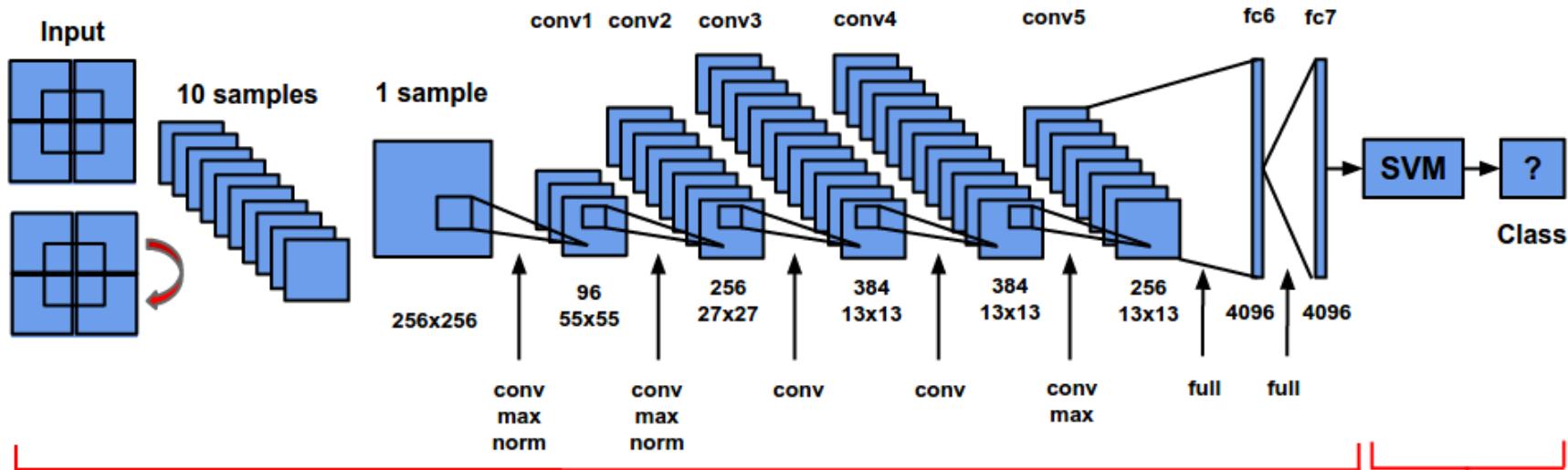
Evolution of Depth



AlexNet (2012)

8 layers

16.4 error rate



Extract high level features

Classify each sample

© 2015 Jeremy Karnowski

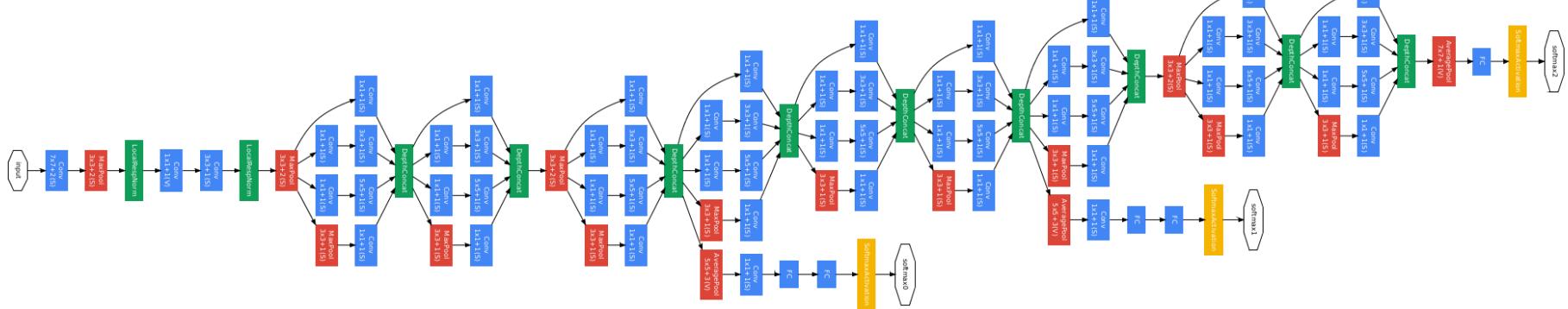


STUDENT DEVELOPER PROGRAM

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/CNN_MNIST_Keras.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>



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	Intel® Math Kernel Library  Intel® MKL	MKL-DNN 	Intel® MLSL 	Intel® Data Analytics Acceleration Library (DAAL) 	Distribution 	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>

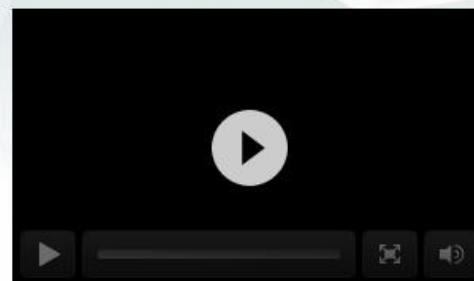
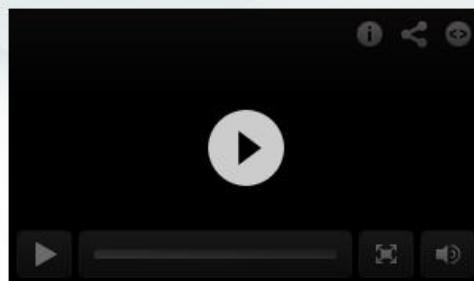


NEXT STEPS....

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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>

ONLINE COURSES

- Stanford Convolutional Neural Networks
for Visual Recognition: <http://cs231n.github.io>
- MIT Machine Learning and Neural Networks:
<http://www.ai.mit.edu/courses/6.891-f99>
- MIT Self Driving Cars: <https://selfdrivingcars.mit.edu>
- Deep Learning AI: <https://www.deeplearning.ai>
- Coursera: <https://www.coursera.org>
- Udacity: <https://www.udacity.com>
- Udemy: <https://www.udemy.com>
- ...

TURKISH CONTENT

- Deep Learning Türkiye:

<https://github.com/deeplearningturkiye/turkce-yapay-zeka-kaynaklari>



Competitions

13 active competitions

Sort by ▼[Active](#) [All](#) [Entered](#)

All Categories ▼

Search **Zillow Prize: Zillow's Home Value Prediction (Zestimate)**

Can you improve the algorithm that changed the world of real estate?

Featured - 7 months to go

\$1,200,000

847 teams

**Intel & MobileODT Cervical Cancer Screening**

Which cancer treatment will be most effective?

Featured - 6 days to go

\$100,000

848 teams

**Planet: Understanding the Amazon from Space**

Use satellite data to track the human footprint in the Amazon rainforest

\$60,000

469 teams

<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



STUDENT DEVELOPER PROGRAM