Applied Deep Learning

Nitish Bhardwaj

Compiled By Nitish Bhardwaj
https://www.linkedin.com/in/nitish-bhardwaj/

Overview of Session :

- Deep Learning Introduction
- Application
- Image Classification
- Object Detection

Compiled By Nitish Bhardwaj
https://www.linkedin.com/in/nitish-bhardwaj/

Deep Learning : Introduction

Compiled By Nitish Bhardwaj
https://www.linkedin.com/in/nitish-bhardwaj/

Why is everyone talking about **Deep Learning**?

- DL is working really well (with awesome *accuracy numbers*) to solve some big problems like Image classification, Face Recognition, Recommendation system, Sentiment Analysis and a lot more.
- **These problems are solved in 90s, aren't they ??** Then why Deep Learning? Because accuracy matters a lot and really a lot.
- DL has transformed the industry by solving these *already solved problems* with ***great accuracy numbers***.
    - For example, *detection of hand-written digits*, *accuracy on test data*
        - ***88%*** *(LeCun et al. 1998) to*
        - ***99.7%*** *(Ciresan et al. CVPR 2012).*
- DL has also brought solutions to many unsolved problems.
- Open-source + Academic Industry collaboration + Fight for Accuracy

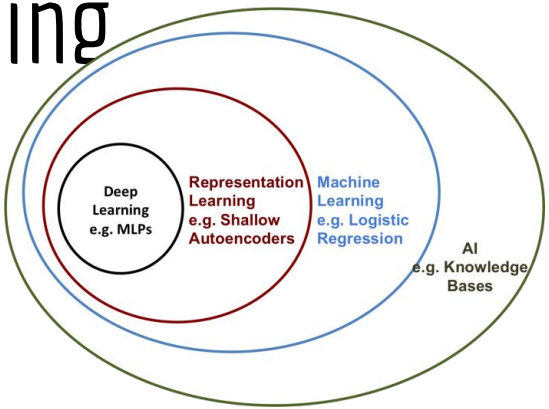
Compiled By Nitish Bhardwaj
https://www.linkedin.com/in/nitish-bhardwaj/

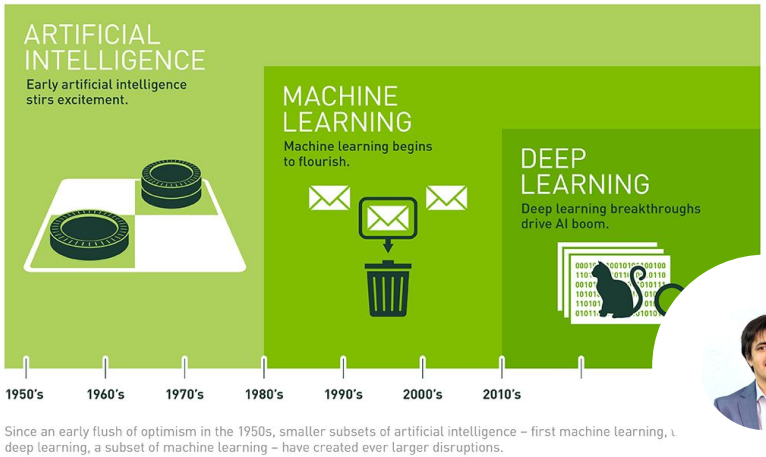
AI vs Machine learning vs Deep learning

AI (*technique to enable machine to mimic humans*) is super-set of ML

ML (*program machines to learn and improve with experience*) and **ML** is the super-set of **DL**.

DL (*achieve great power and flexibility by learning to* ***represent the data as nested hierarchy of concepts****, i.e, more depth features with multiple processing layers, hence "deep").*



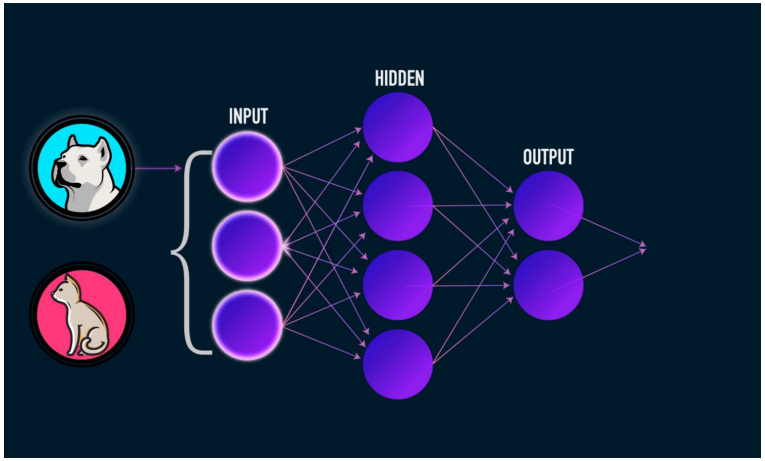


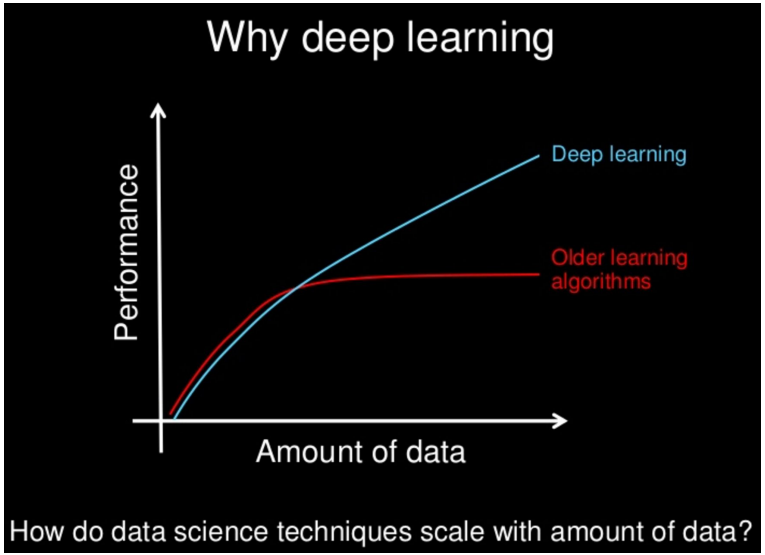
Since an early flush of optimism in the 1950s, smaller subsets of artificial intelligence – first machine learning, t
deep learning, a subset of machine learning – have created ever larger disruptions.

Compiled By Nitish Bhardwaj
https://www.linkedin.com/in/nitish-bhardwaj/

Deep Learning

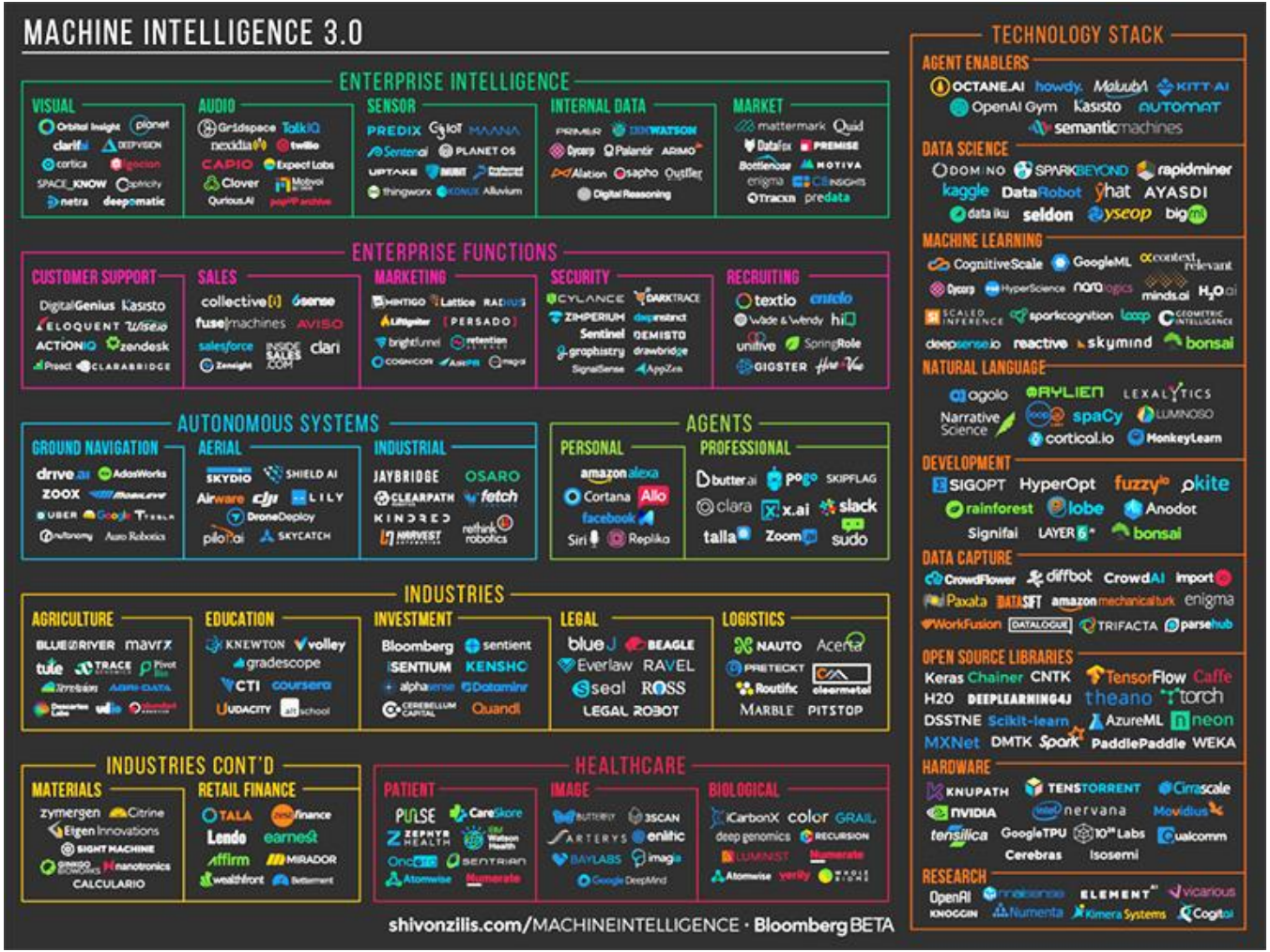
- Based on Concept on Artificial Neural Networks
- "*The hierarchy of concepts allows the computer to learn complicated concepts by building them out of simpler ones. If we draw* ***a graph showing how these concepts are built on top of each other****, the graph is deep, with many layers. For this reason, we call this approach to AI deep learning.*" - Ian GoodFellow



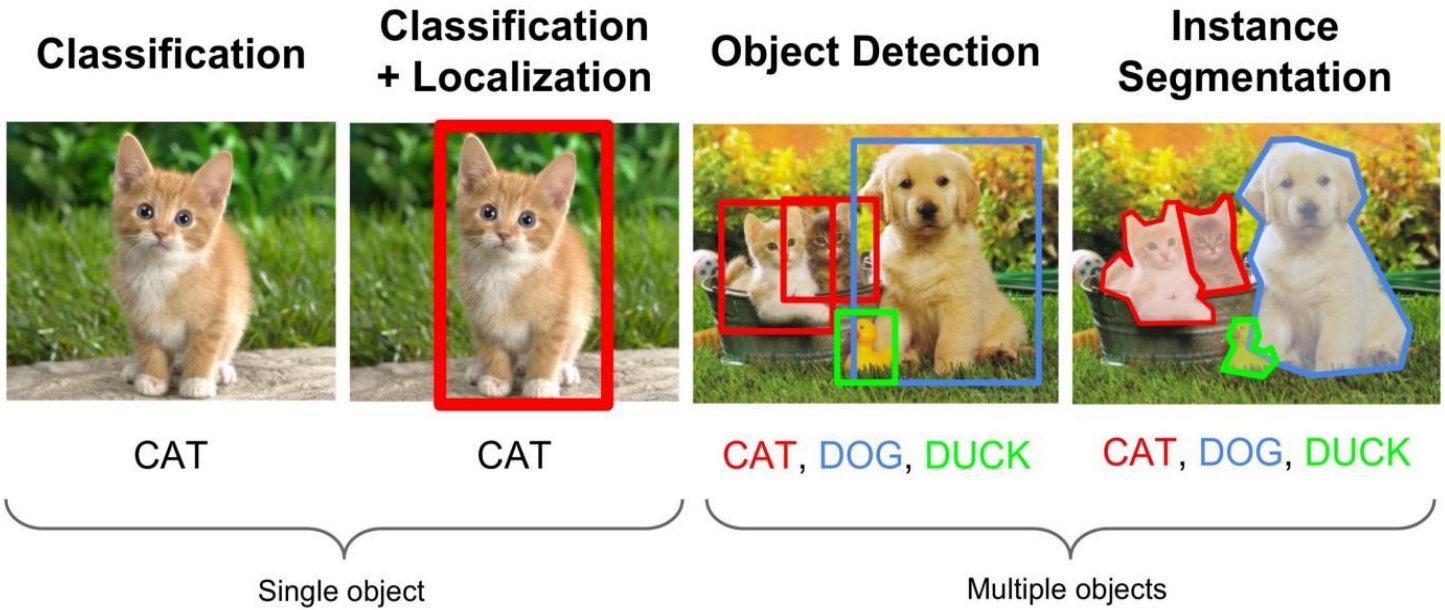


Applications

Compiled By Nitish Bhardwaj
https://www.linkedin.com/in/nitish-bhardwaj/


MACHINE INTELLIGENCE 3.0
ENTERPRISE INTELLIGENCE
VISUAL
AUDIO
SENSOR
INTERNAL DATA
MARKET
ENTERPRISE FUNCTIONS
CUSTOMER SUPPORT
SALES
MARKETING
SECURITY
RECRUITING
AUTONOMOUS SYSTEMS
GROUND NAVIGATION
AERIAL
INDUSTRIAL
AGENTS
PERSONAL
PROFESSIONAL
INDUSTRIES
AGRICULTURE
EDUCATION
INVESTMENT
LEGAL
LOGISTICS
INDUSTRIES CONT'D
MATERIALS
RETAIL FINANCE
HEALTHCARE
PATIENT
IMAGE
BIOLOGICAL
shivonzilis.com/MACHINEINTELLIGENCE · Bloomberg BETA
TECHNOLOGY STACK
AGENT ENABLERS
DATA SCIENCE
MACHINE LEARNING
NATURAL LANGUAGE
DEVELOPMENT
DATA CAPTURE
OPEN SOURCE LIBRARIES
HARDWARE
RESEARCH

Deep learning with Images : **Computer Vision**

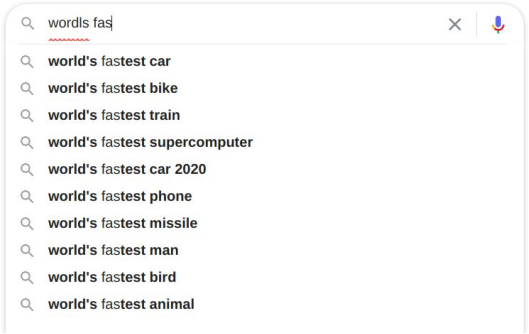


- Classification
- Detection
- Segmentation
- Generation
- And Lot more

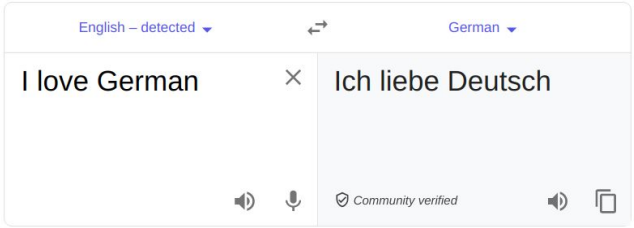
Compiled By Nitish Bhardwaj
https://www.linkedin.com/in/nitish-bhardwaj/

Deep Learning with Text : **Natural Language Processing**

Search Autocorrect and Autocomplete



Language Translation



- Text Classification
- Chatbots
- Voice Assistants
- Social Media Analytics
- Advertisements
- Summarization
- And lot more

Compiled By Nitish Bhardwaj
https://www.linkedin.com/in/nitish-bhardwaj/

Deep Learning with Number data :

Stock Market Prediction

	Date	Open	High	Low	Last	Close	Total Trade Quantity	Turnover (Lacs)
0	2018-10-08	208.00	222.25	206.85	216.00	215.15	4642146.0	10062.83
1	2018-10-05	217.00	218.60	205.90	210.25	209.20	3519515.0	7407.06
2	2018-10-04	223.50	227.80	216.15	217.25	218.20	1728786.0	3815.79
3	2018-10-03	230.00	237.50	225.75	226.45	227.60	1708590.0	3960.27
4	2018-10-01	234.55	234.60	221.05	230.30	230.90	1534749.0	3486.05

- House Price Prediction
- Recommendation system
- Disease Identification
- Medical Reporting
- And lot more

Compiled By Nitish Bhardwaj
https://www.linkedin.com/in/nitish-bhardwaj/

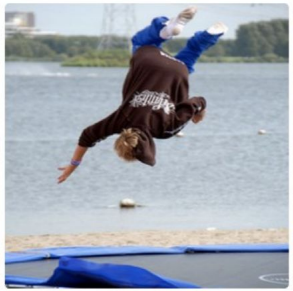
Complex Deep Learning

Image Captioning

"man in black shirt is playing guitar."

"construction worker in orange safety vest is working on road."

"two young girls are playing with lego toy."



"boy is doing backflip on wakeboard."

Images

Text

Compiled By Nitish Bhardwaj
https://www.linkedin.com/in/nitish-bhardwaj/

Deep Neural Networks

Compiled By Nitish Bhardwaj
https://www.linkedin.com/in/nitish-bhardwaj/

Dataset

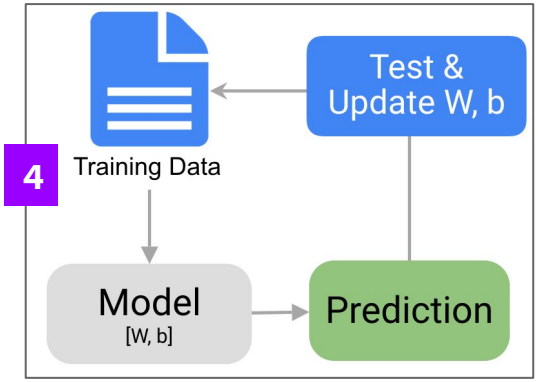
Inputs			Output
x1	**x2**	**x3**	**y**
1.4	2.7	1.9	0
3.8	3.4	3.2	0
6.4	2.8	1.7	1
4.1	0.1	0.2	0

Problem solving in 7 steps

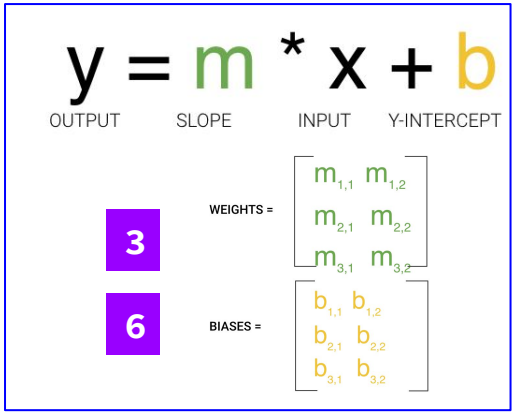
1. Problem Statement
2. Data Preparation
3. Choosing a **model, y=f (x)**
4. **Training**
5. Evaluation / **Validation**
6. Hyperparameter tuning
7. Prediction/**Testing**

1 Classification Problem

2 Data Preparation

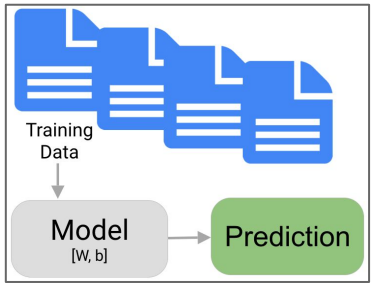


4

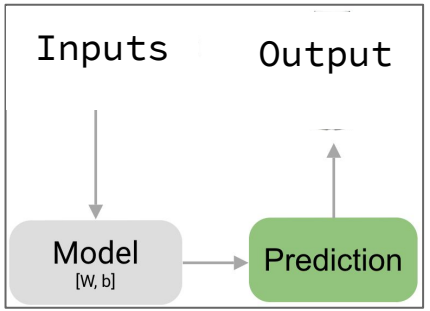


3

6



5

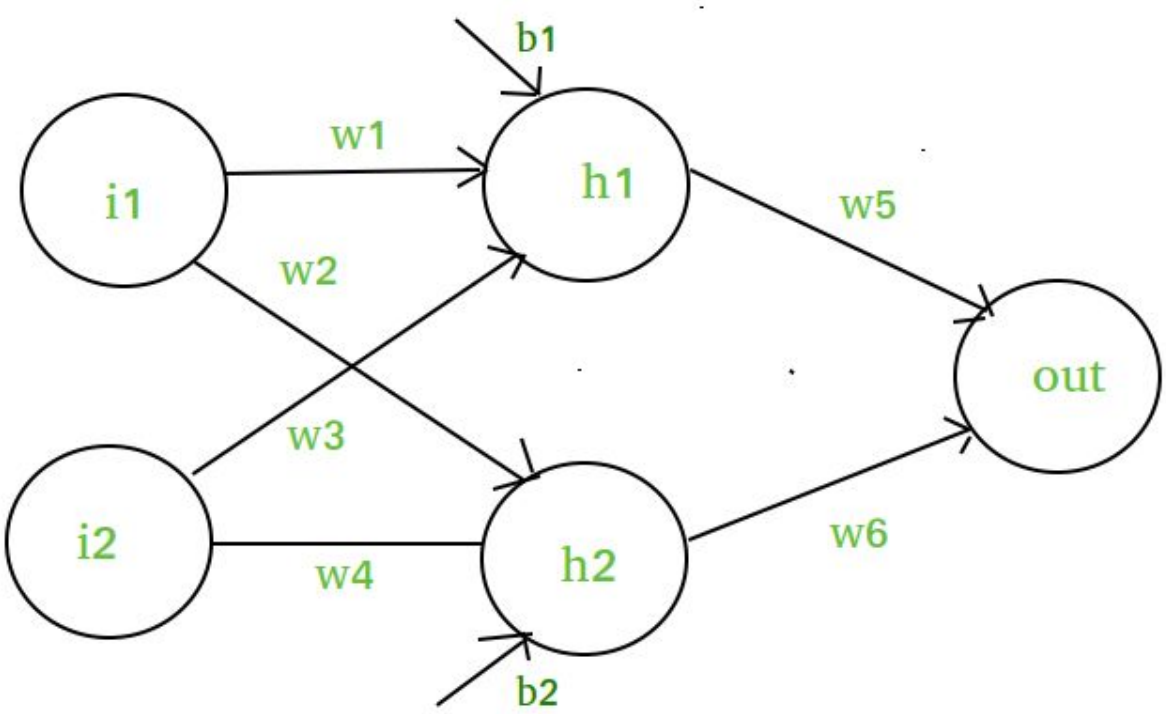


7

Problem Solving :

Inputs			Output
x1	**x2**	**x3**	**y**
1.4	2.7	1.9	0
3.8	3.4	3.2	0
6.4	2.8	1.7	1
4.1	0.1	0.2	0

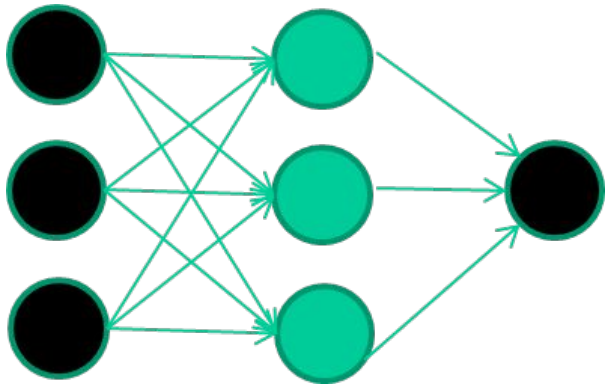
Weights and Biases in Neural network



A dataset

Fields			***class***
1.4	2.7	1.9	0
3.8	3.4	3.2	0
6.4	2.8	1.7	1
4.1	0.1	0.2	0

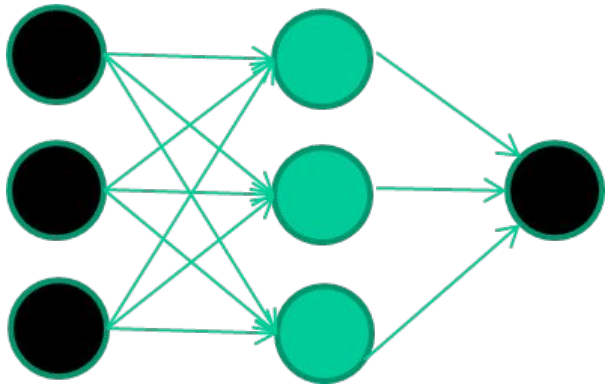
etc …



Training the neural network

Fields			***class***
1.4	2.7	1.9	0
3.8	3.4	3.2	0
6.4	2.8	1.7	1
4.1	0.1	0.2	0

etc …

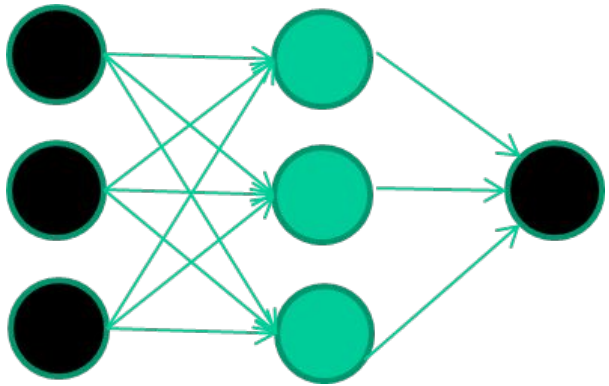


Training data

Fields			***class***
1.4	2.7	1.9	0
3.8	3.4	3.2	0
6.4	2.8	1.7	1
4.1	0.1	0.2	0

etc …

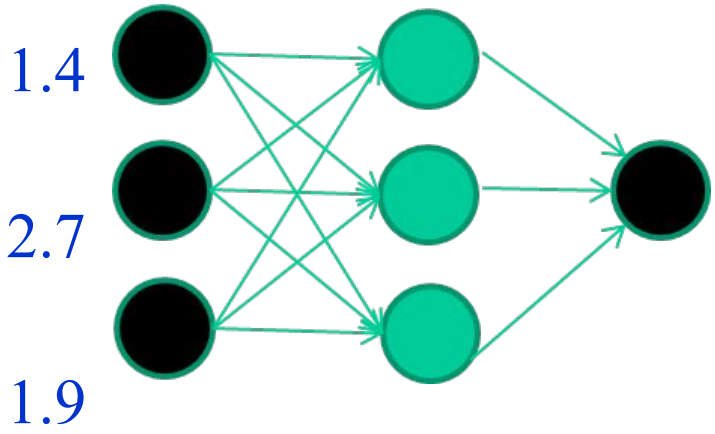
Initialise with random weights and bias



Training data

Fields			***class***
1.4	2.7	1.9	0
3.8	3.4	3.2	0
6.4	2.8	1.7	1
4.1	0.1	0.2	0
etc …			

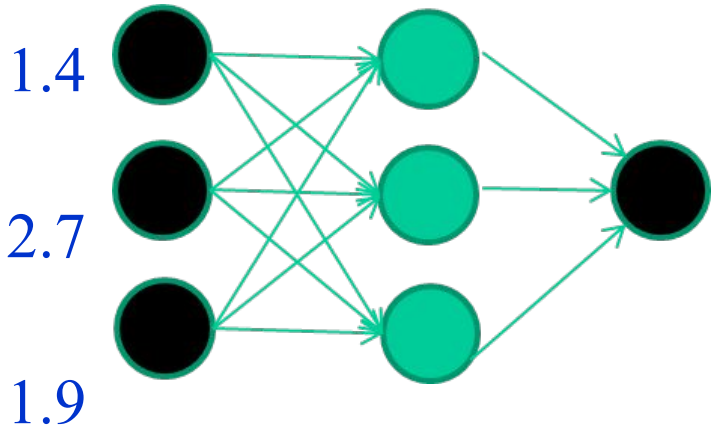
Present a Training Pattern



Training data

Fields			***class***
1.4	2.7	1.9	0
3.8	3.4	3.2	0
6.4	2.8	1.7	1
4.1	0.1	0.2	0
etc …			

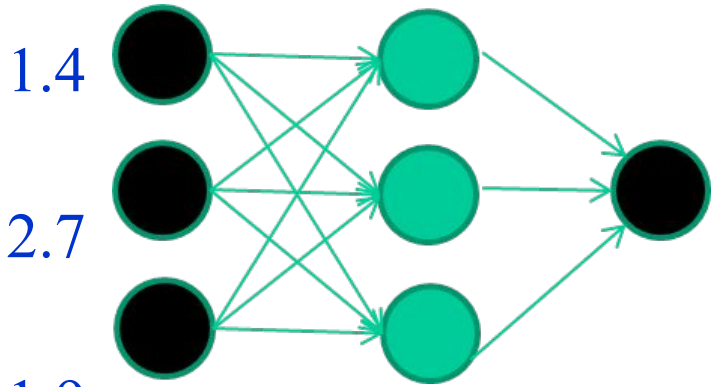
Feed it through the output



Training data

Fields			***class***
1.4	2.7	1.9	0
3.8	3.4	3.2	0
6.4	2.8	1.7	1
4.1	0.1	0.2	0
etc …			

Compare with target output



0.8

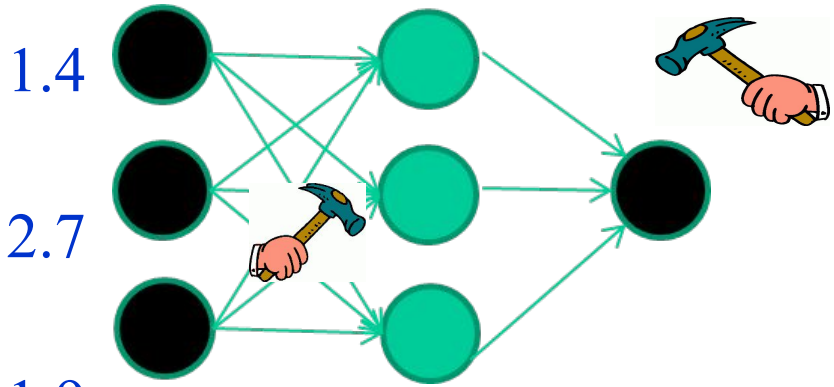
0

error 0.8

Training data

Fields			***class***
1.4	2.7	1.9	0
3.8	3.4	3.2	0
6.4	2.8	1.7	1
4.1	0.1	0.2	0
etc …			

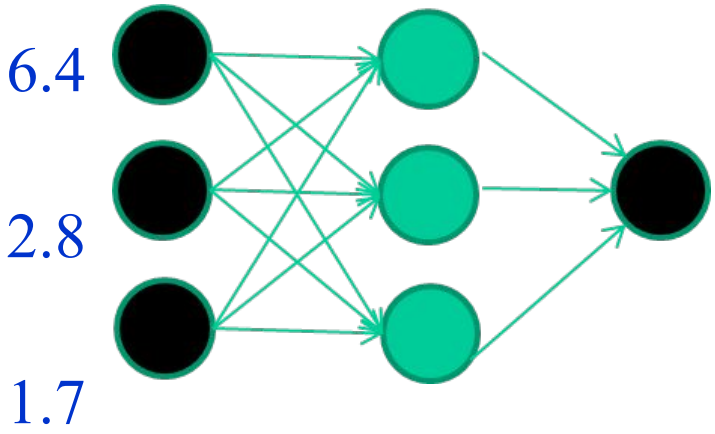
Adjust weights based on error



Training data

Fields			***class***
1.4	2.7	1.9	0
3.8	3.4	3.2	0
6.4	2.8	1.7	1
4.1	0.1	0.2	0
etc …			

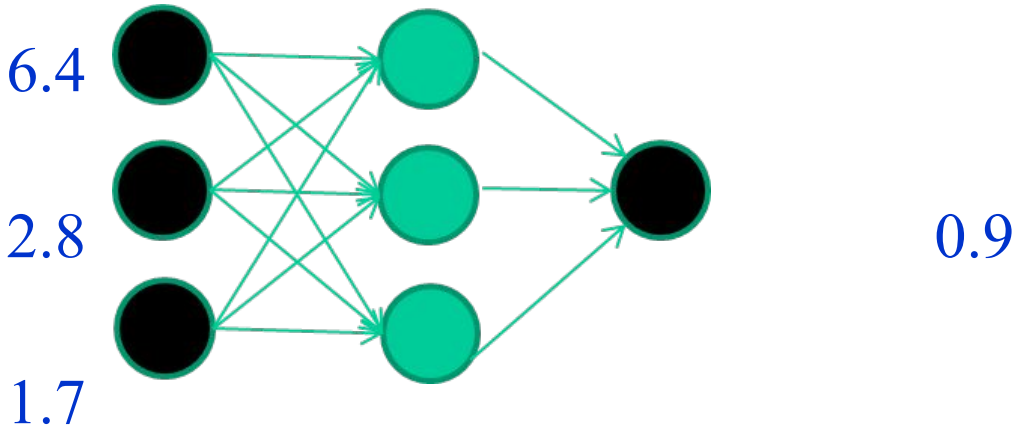
Present a Training Pattern



Training data

Fields			***class***
1.4	2.7	1.9	0
3.8	3.4	3.2	0
6.4	2.8	1.7	1
4.1	0.1	0.2	0
etc …			

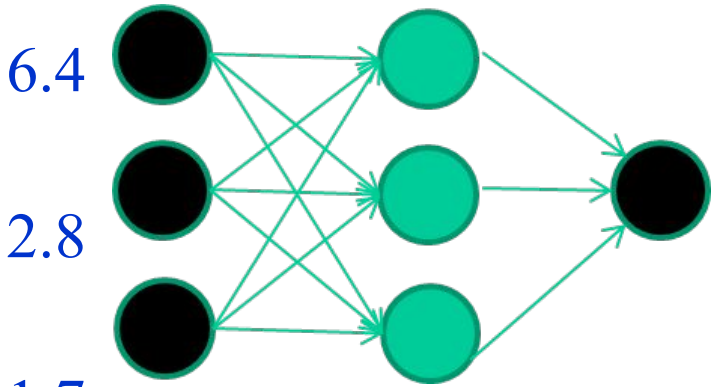
Feed it through the output



Training data

Fields			***class***
1.4	2.7	1.9	0
3.8	3.4	3.2	0
6.4	2.8	1.7	1
4.1	0.1	0.2	0
etc …			

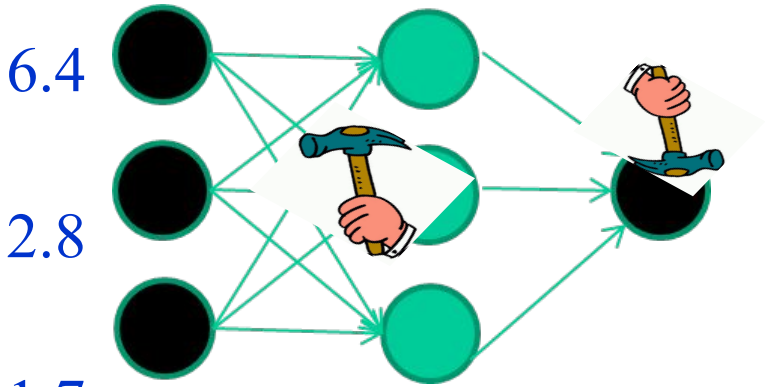
Compare with target output



Training data

Fields			***class***
1.4	2.7	1.9	0
3.8	3.4	3.2	0
6.4	2.8	1.7	1
4.1	0.1	0.2	0
etc …			

Adjust weights based on error

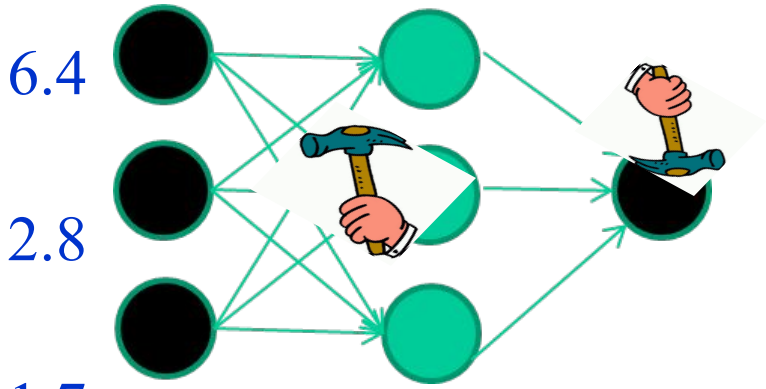


Training data

Fields			***class***
1.4	2.7	1.9	0
3.8	3.4	3.2	0
6.4	2.8	1.7	1
4.1	0.1	0.2	0

etc …

And so on ……..



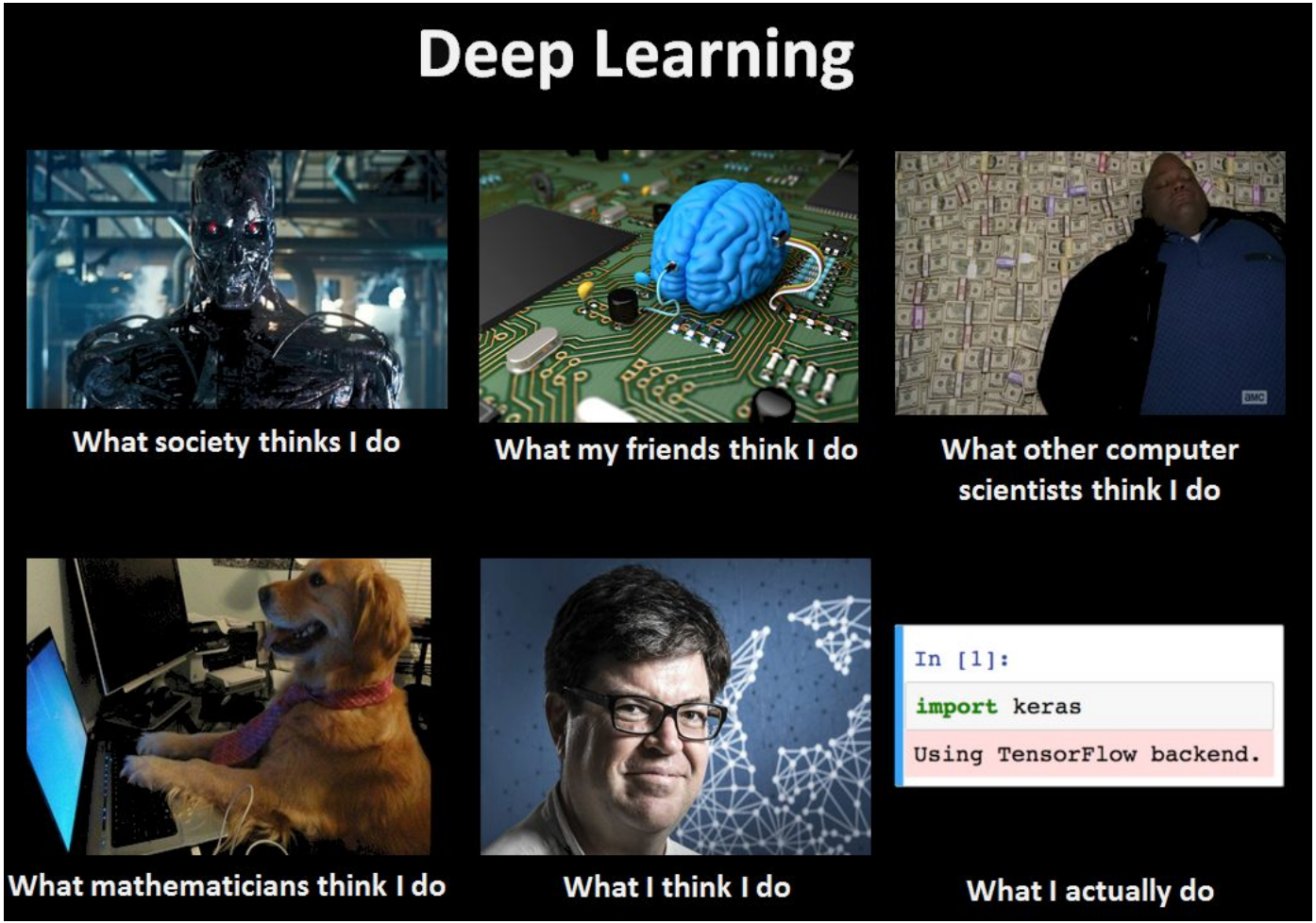
Repeat this thousands, maybe millions of times – each time taking a random training instance, and making slight weight adjustments

Algorithms for weight adjustment are designed to make changes that will reduce the error

Coding Session

Compiled By Nitish Bhardwaj
https://www.linkedin.com/in/nitish-bhardwaj/

Let's Deep Dive



Let's code...

Jupyter Notebook

The Jupyter Notebook is a web-based interactive computing platform that allows users to author data- and code-driven narratives that combine live code, equations, narrative text, visualizations, interactive dashboards and other media.

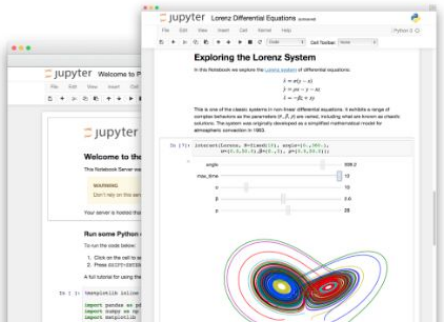
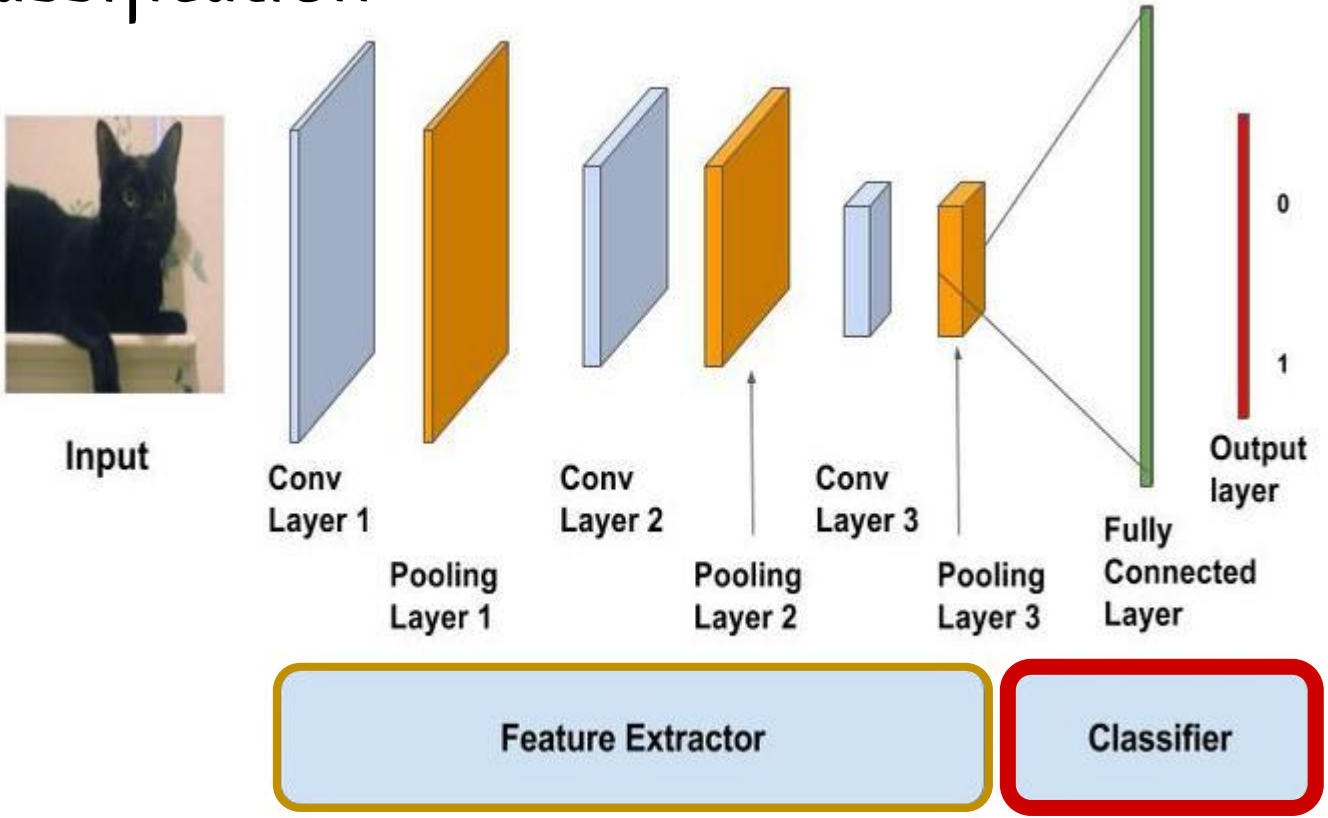


Image Classification

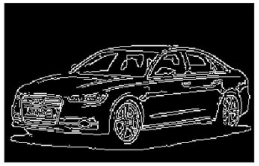
Compiled By Nitish Bhardwaj
https://www.linkedin.com/in/nitish-bhardwaj/

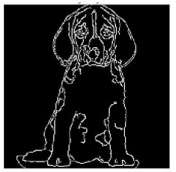
Image classification

Dataset
- Images
- Classes



Feature extraction

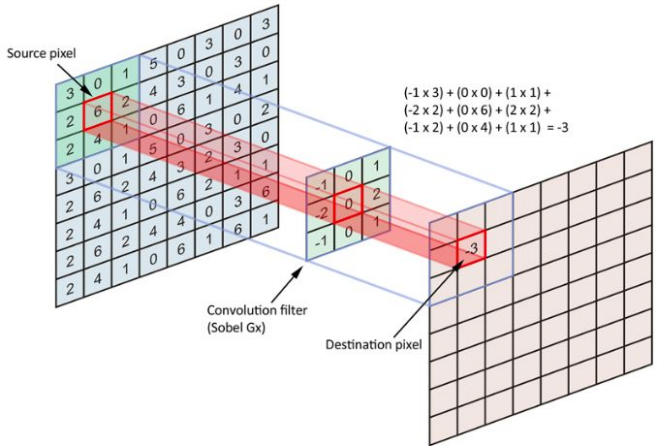




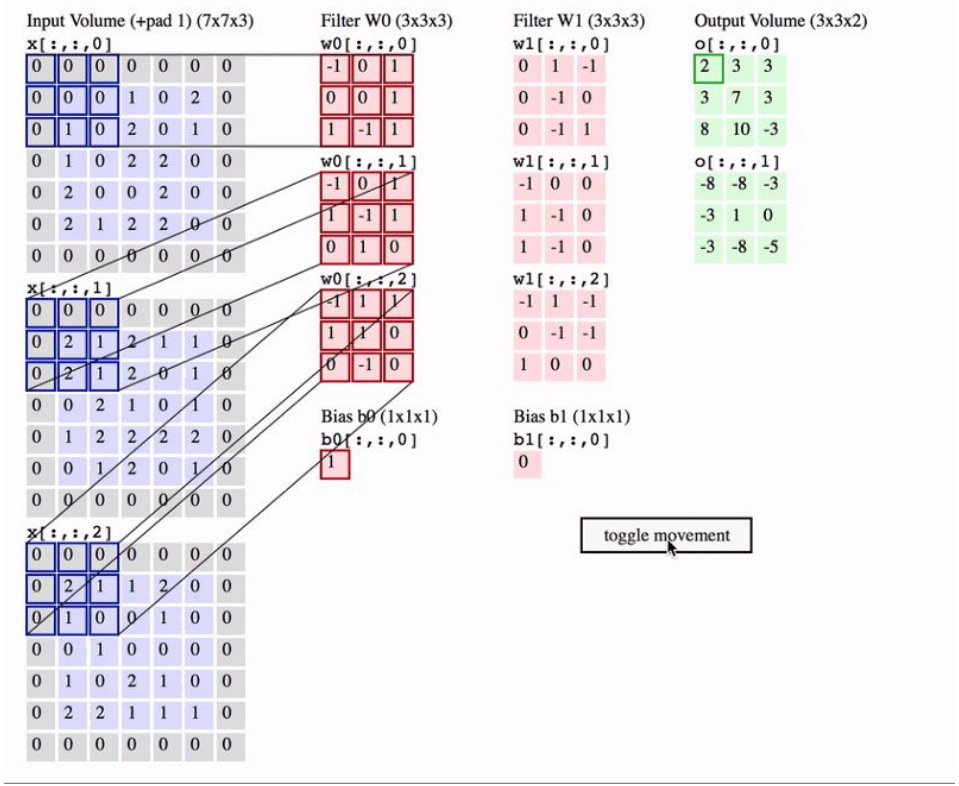
- HOG: Histogram of Oriented Gradients
- SIFT: Scale Invariant Feature Transform
- SURF: Speeded-Up Robust Feature
- **CNN: Convolution Neural Network**

1x1	1x0	1x1	0	0
0x0	1x1	1x0	1	0
0x1	0x0	1x1	1	1
0	0	1	1	0
0	1	1	0	0

4		



Convolution neural Network



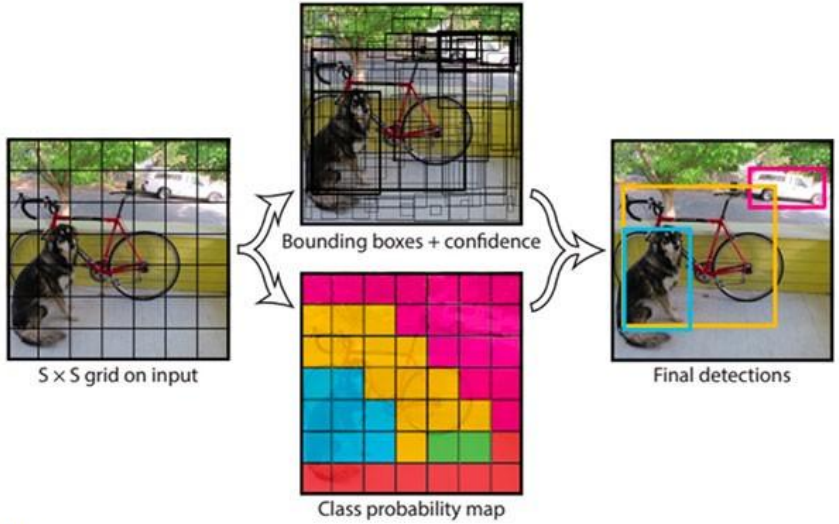
Object Detection

Compiled By Nitish Bhardwaj
https://www.linkedin.com/in/nitish-bhardwaj/

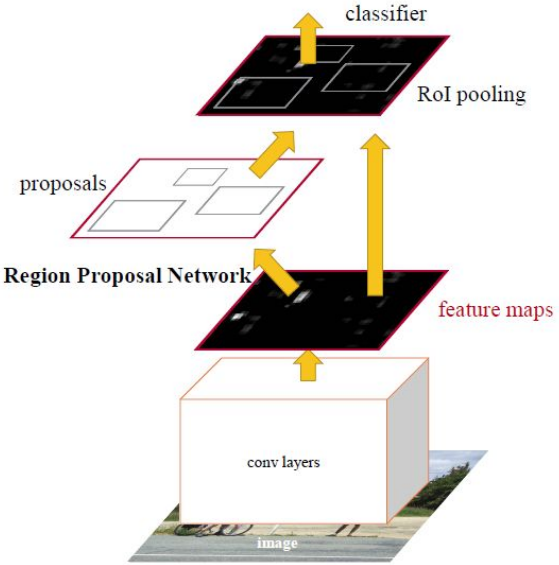
Object detection

Dataset

- Images
- Bounding Boxes(x,y,w,h)
- Classes



Region Proposal Network, providing a number of regions which are then passed to common DL based classification architectures



With the need of real time object detection, many one-step object detection architectures have been proposed, like YOLO, YOLOv2, YOLOv3, SSD, RetinaNet etc. which try to combine the detection and classification step.

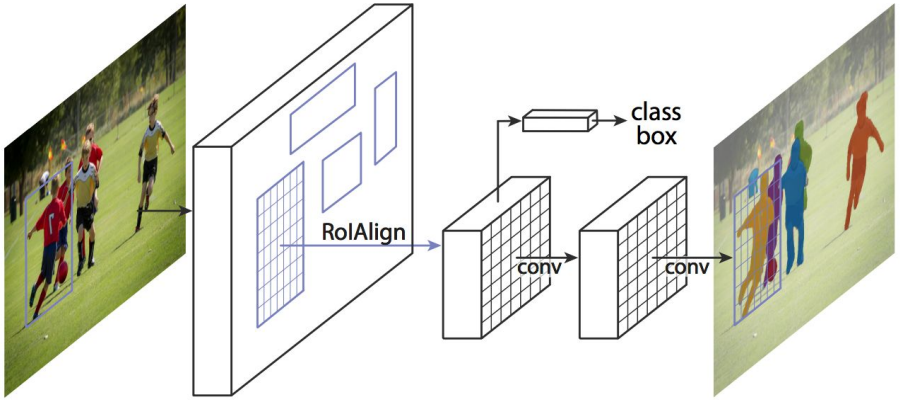
Examples

Compiled By Nitish Bhardwaj
https://www.linkedin.com/in/nitish-bhardwaj/

Segmentation

Dataset

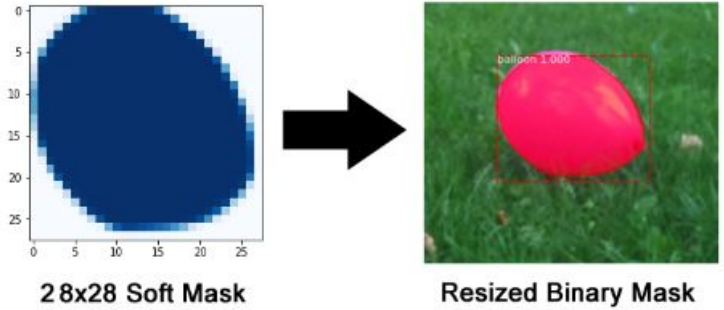
- Images
- Coordinates[list of (x,y)]
- Classes



Segmentation Masks

The mask branch is CNN that takes the positive regions selected by the ROI classifier and generates masks for them.

The generated masks are low resolution: 28x28 pixels. But they are soft masks, represented by float numbers, so they hold more details than binary masks.



Face recognition

[redacted]

Facebook automatically tags people in your photos that you have tagged before. I'm not sure if this is helpful or creepy! :P

Dataset

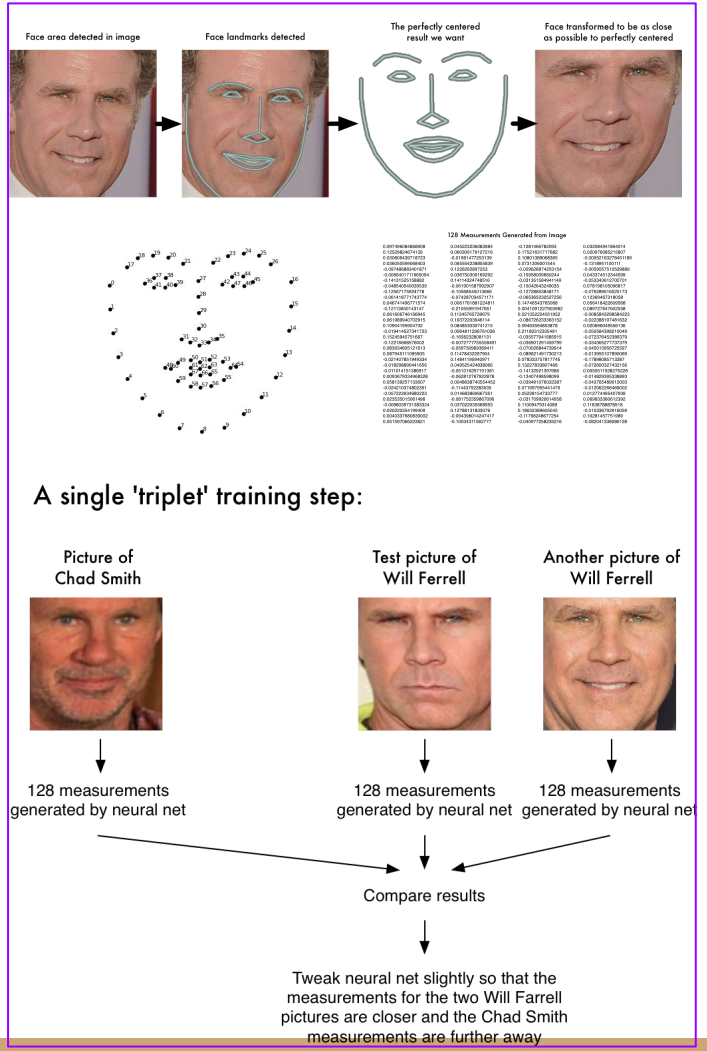
- Images
- Classes

Algorithm:

- Face Detection
- Face Alignment

- DeepNet Model to extract features
  Pass the centered face image through a neural network that knows how to measure features of the face. Save those 128 measurements.

- *Testing new face : Extract 128 measurements and find the most similar match*



Style transfer

- Problem Statement
  - Given:
    - Content Image
    - Style Image
  - Result:
    - Stylized Image
- Algorithm
  - Feature Extraction of Content (A)
  - Feature Extraction of Style (B)
  - Merge Features(A+B)

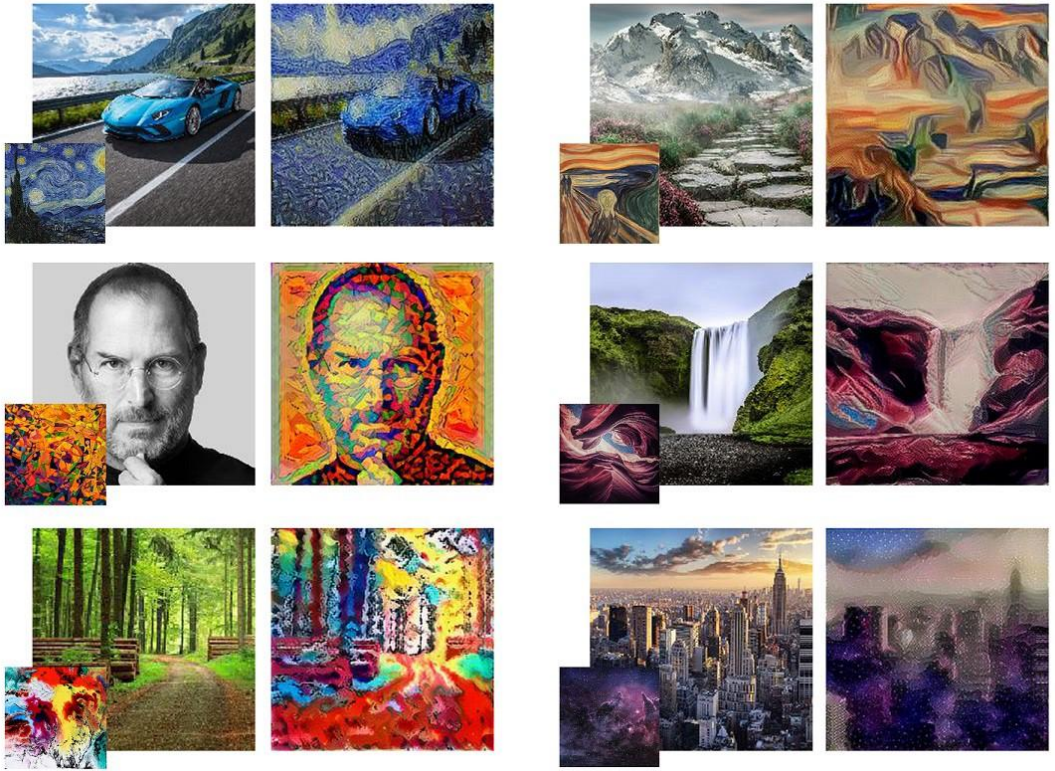
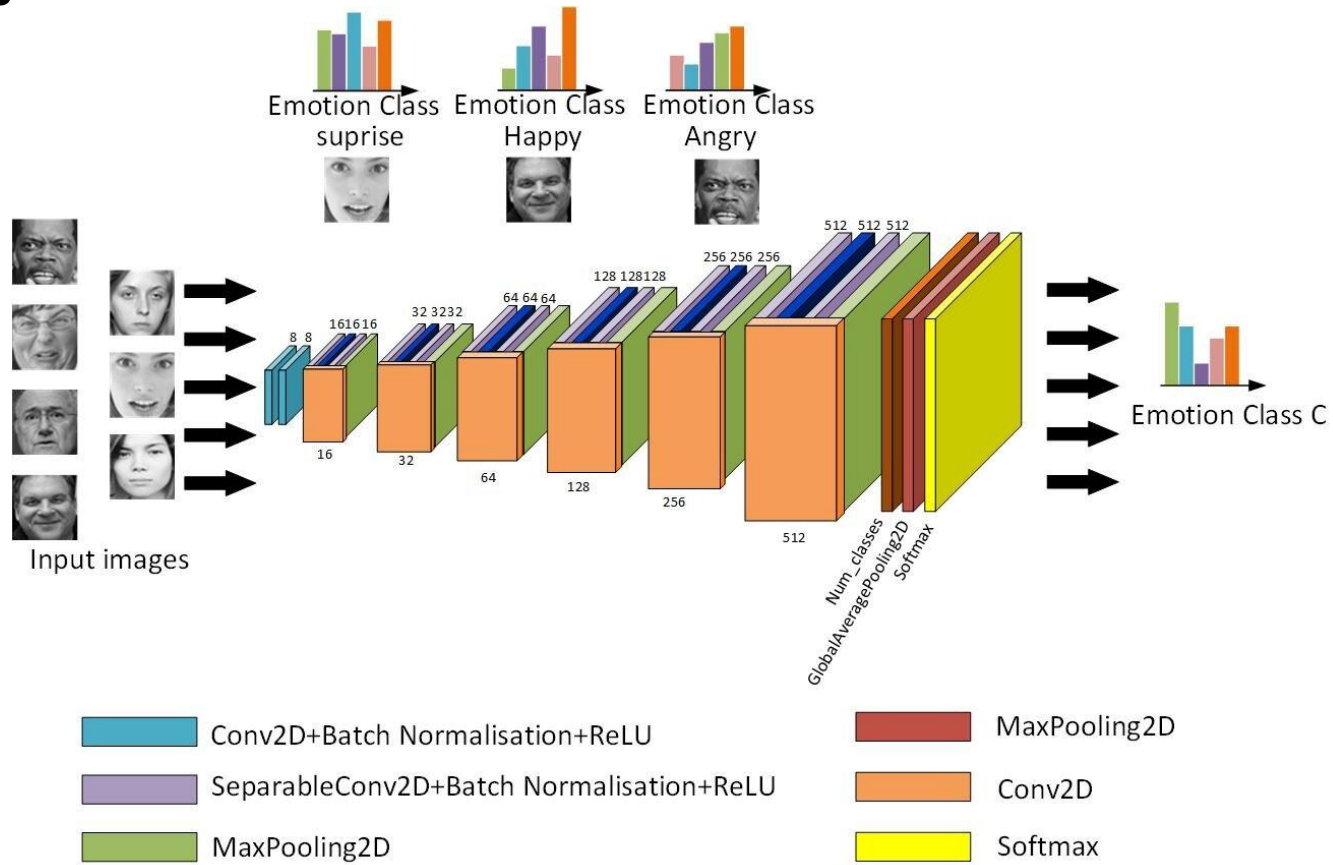


Image analytics

1. Problem Statement
2. Data Preparation
3. Choosing **model(s)**
   a. **Training**
   b. Evaluation / **Validation**
   c. Hyperparameter tuning
   d. Prediction/**Testing**
4. Combine Results
5. Presentation



Summary

- AI to Deep Learning
- Neural networks to Deep nets
- Problem Solving
- Coding session
  - Image Classification
  - Convolutional Neural network
  - Object Detection
  - Segmentation
- More examples

Compiled By Nitish Bhardwaj
https://www.linkedin.com/in/nitish-bhardwaj/

References

- https://setosa.io/ev/image-kernels/
- https://poloclub.github.io/cnn-explainer/
- https://towardsdatascience.com/gentle-dive-into-math-behind-convolutional-neural-networks-79a07dd44cf9
- https://www.youtube.com/watch?v=nKW8Ndu7Mjw
- https://www.thispersondoesnotexist.com/
- https://playground.tensorflow.org/
- https://reiinakano.com/arbitrary-image-stylization-tfjs/
- https://blog.insightdatascience.com/generating-custom-photo-realistic-faces-using-ai-d170b1b59255
- https://engineering.matterport.com/splash-of-color-instance-segmentation-with-mask-r-cnn-and-tensorflow-7c761e238b46
- https://github.com/ageitgey/face_recognition
- https://medium.com/@manivannan_data/how-to-train-yolov2-to-detect-custom-objects-9010df784f36

Tutorials

- https://pytorch.org/tutorials/beginner/deep_learning_60min_blitz.html
- https://keras.io/examples/
- https://www.tensorflow.org/learn
- https://www.youtube.com/watch?v=CU6bTEClzlw
- https://www.youtube.com/c/K%C3%A1rolyZsolnai/videos
-

Compiled By Nitish Bhardwaj
https://www.linkedin.com/in/nitish-bhardwaj/

Overview of Session :

- Deep Learning Introduction
- Application
- AI Pipeline
- Image Classification
- Object Detection
- Text Classification
- AI Pipeline
- Industrial Requirement
- Research Topics in Deep Learning
- GAN

Compiled By Nitish Bhardwaj
https://www.linkedin.com/in/nitish-bhardwaj/

Thank You