Introduction to

Machine Learning and Deep Learning

Mehran Safayani

safayani@iut.ac.ir

safayani.iut.ac.ir

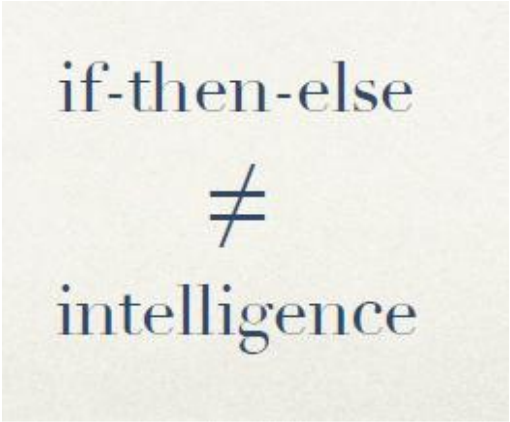
aparat.com/mehran.safayani

github.com/safayani

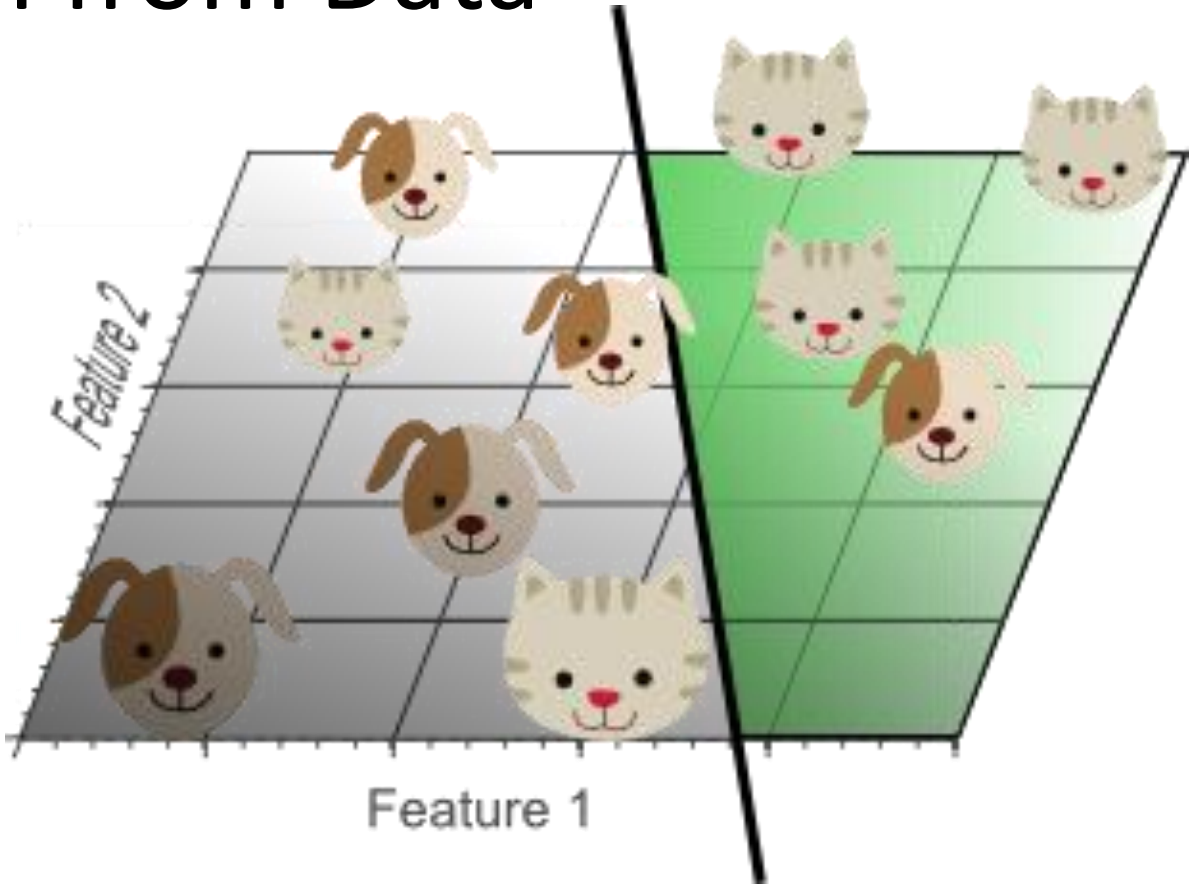
Machine Learning

- Grew out of work in AI
- New capability for computers
- Learn from Data (2.5 quintillion bytes [2.5*10^18] per day)

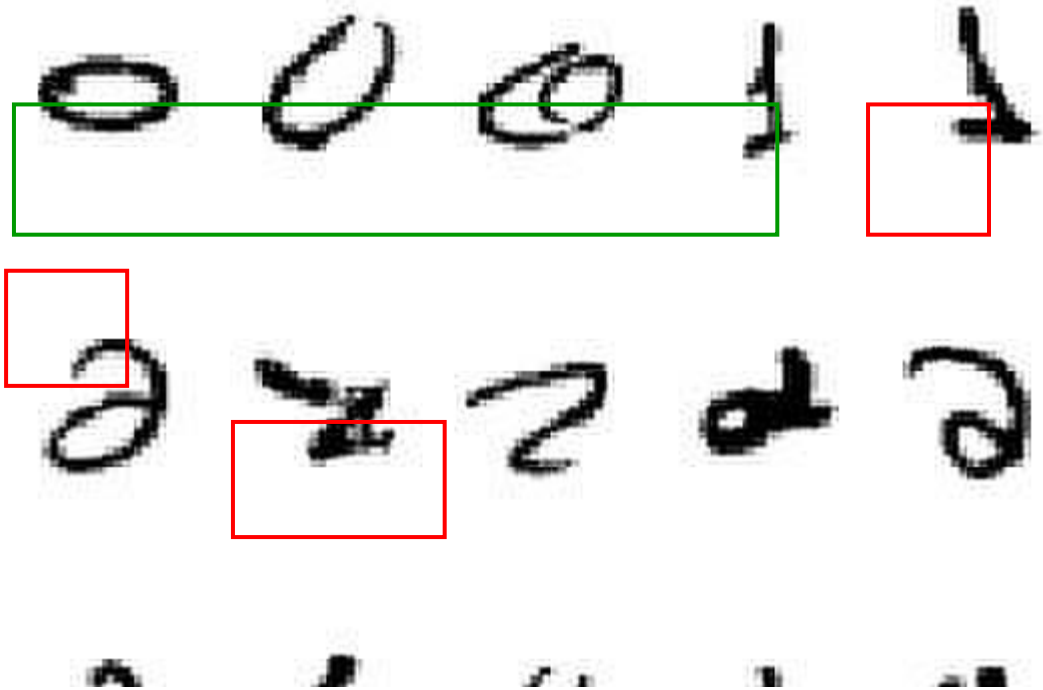
CATs vs DOGs


if-then-else
≠
intelligence

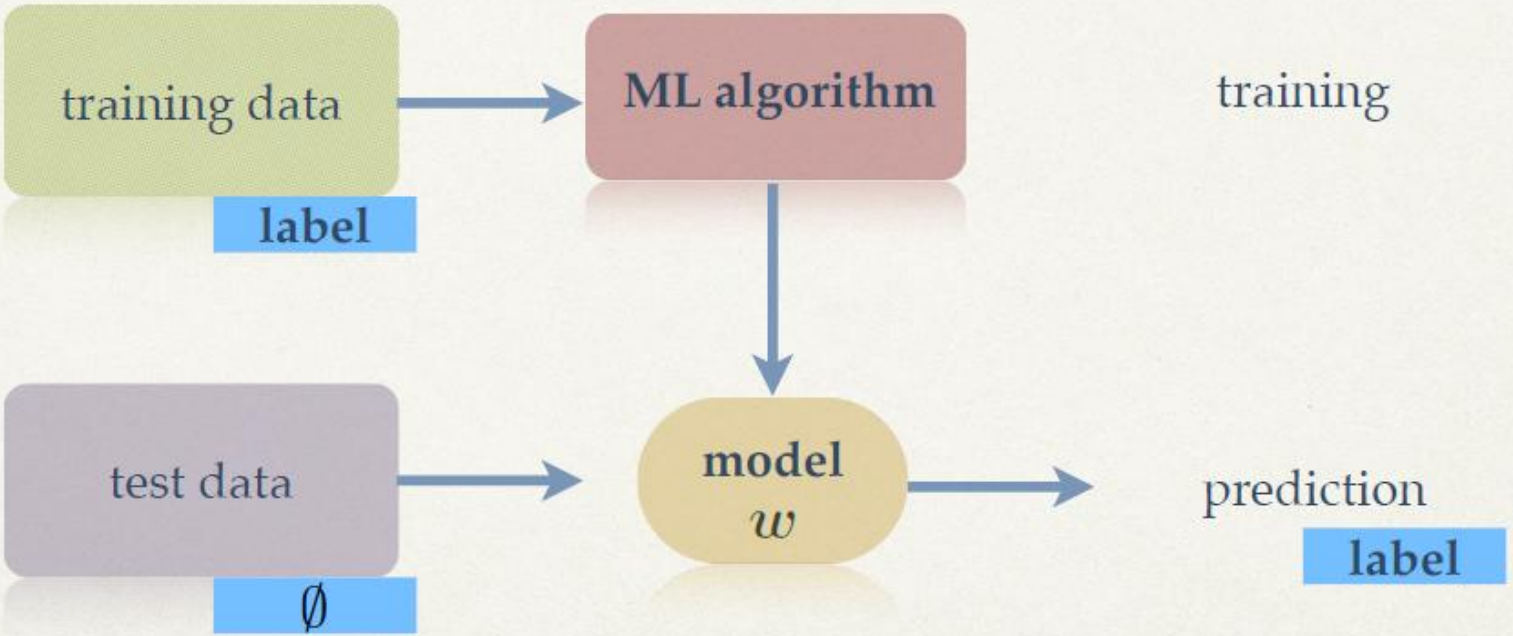
Learn from Data

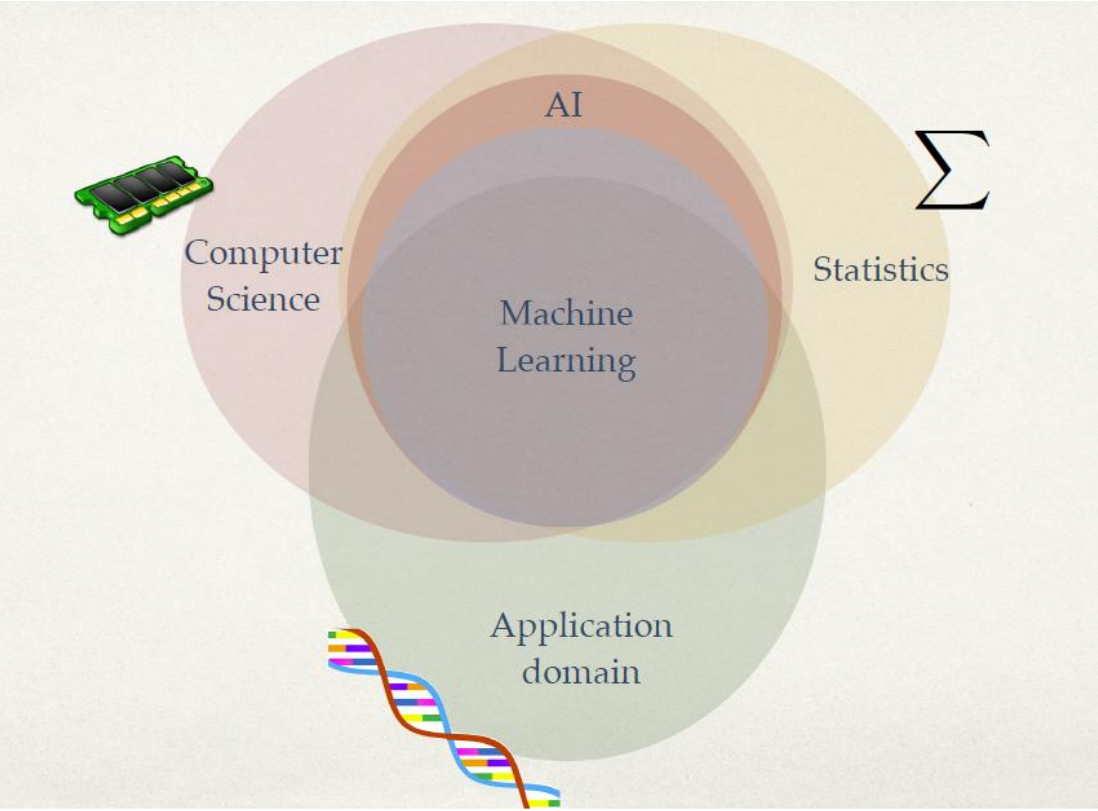


It is very hard to say what makes a 2



Machine Learning Fundamentals

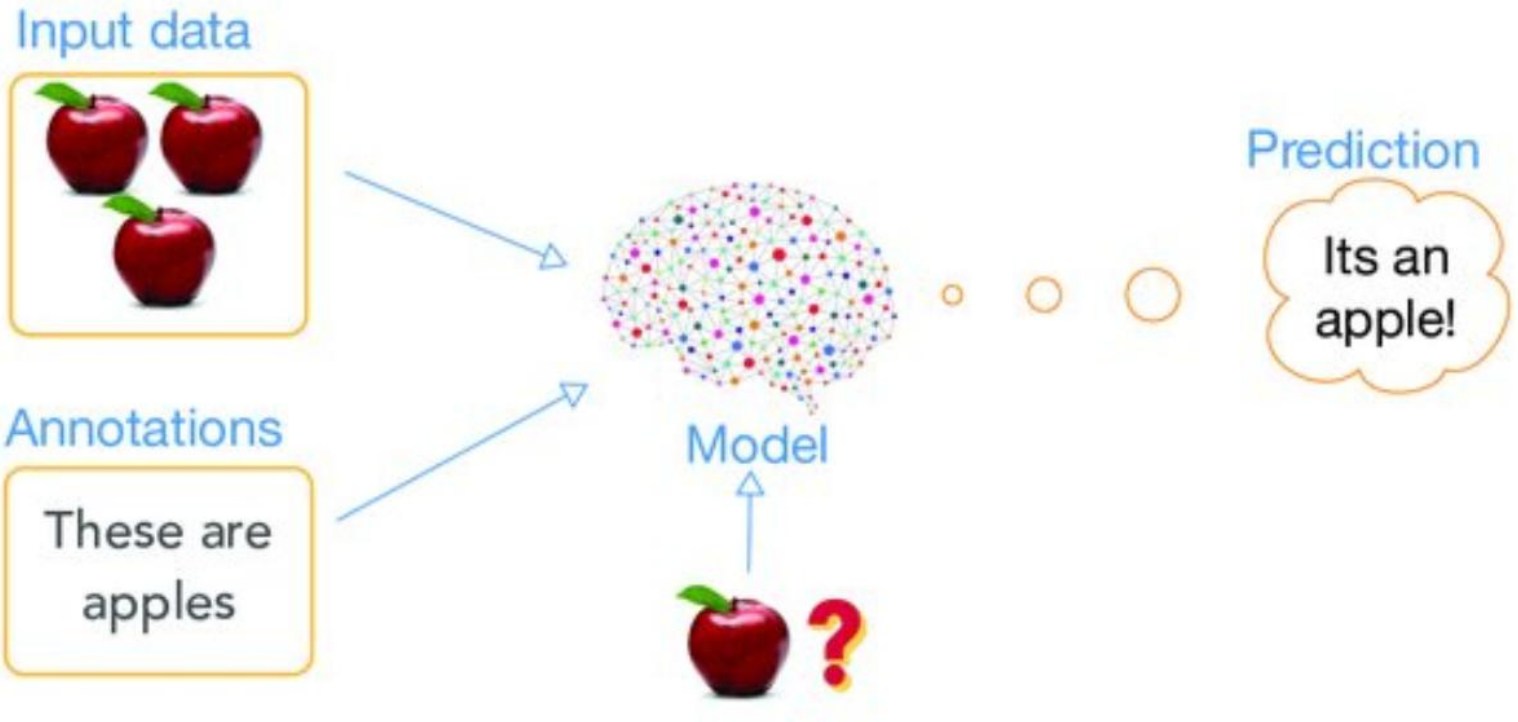



AI
Computer Science
Statistics
Machine Learning
Application domain

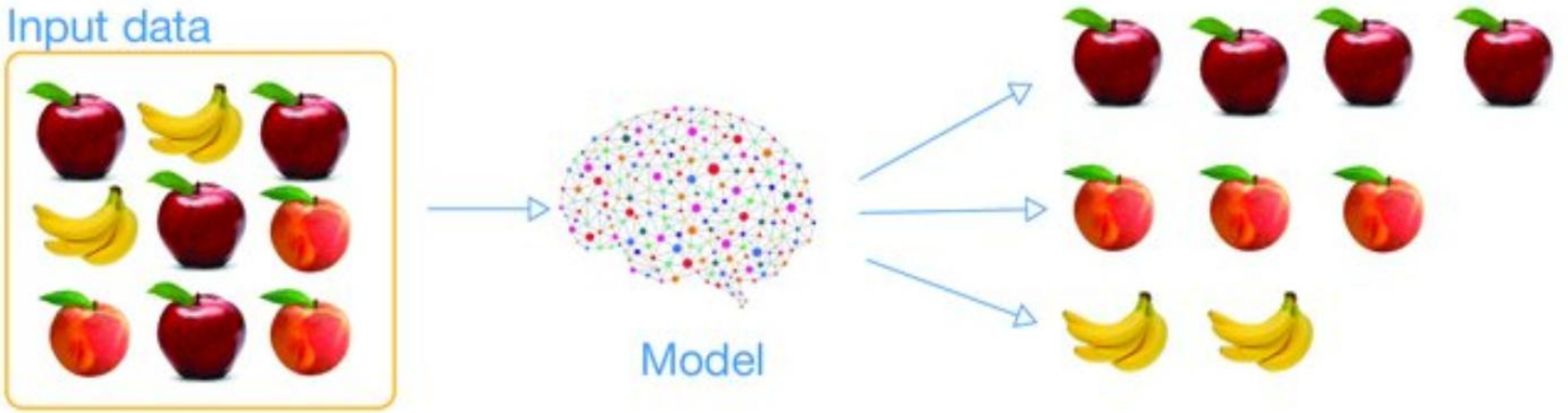
Different types of learning

- Supervised learning
- Unsupervised learning
- Reinforcement learning

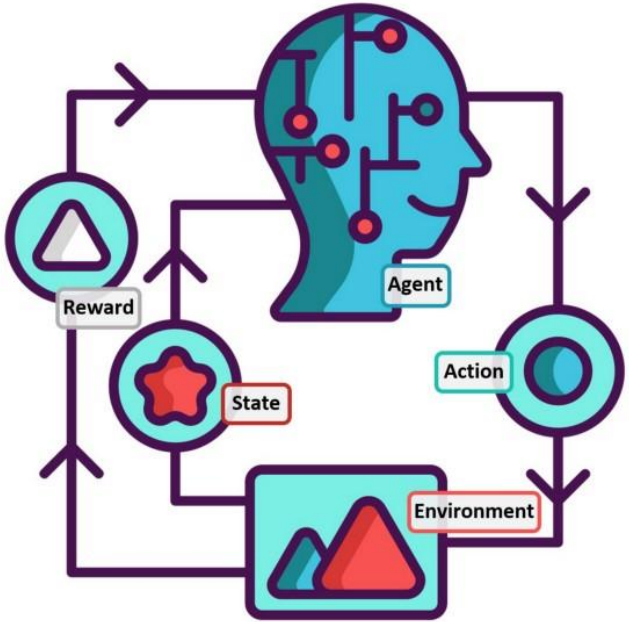
Supervised Learning



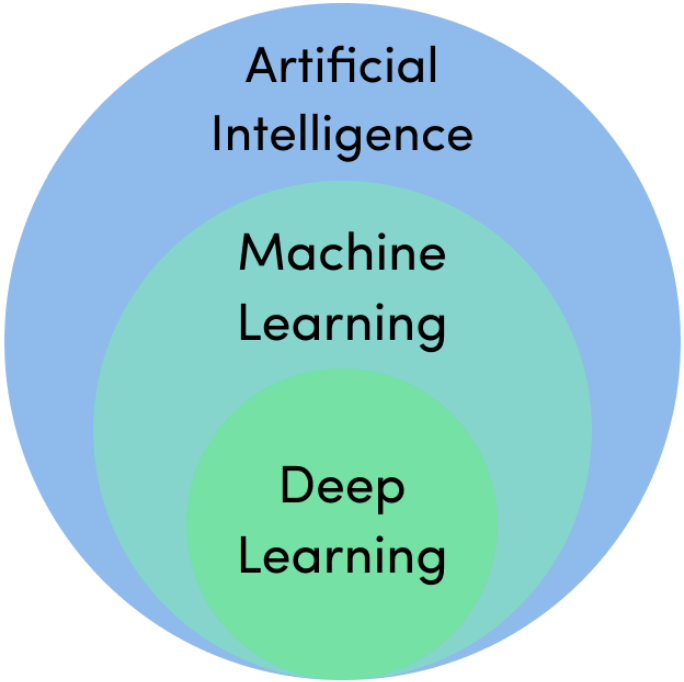
Unsupervised Learning



Reinforcement Learning

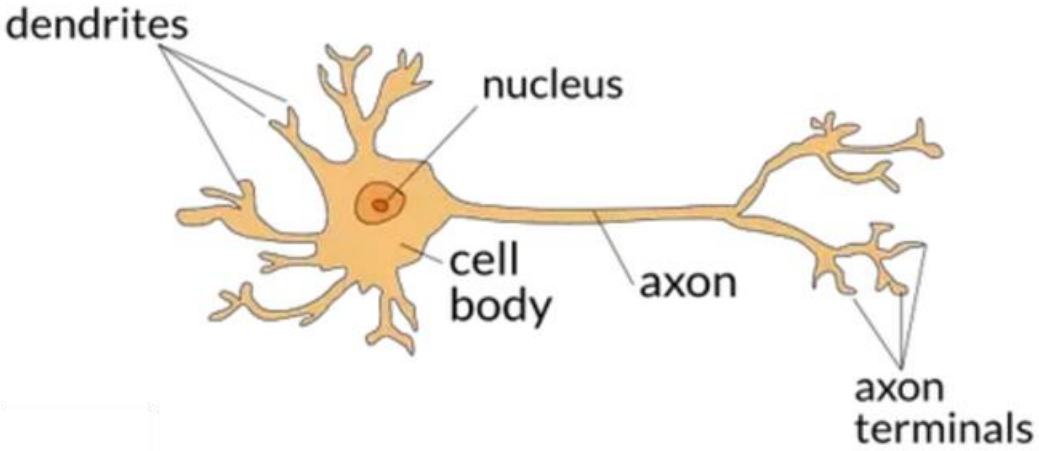


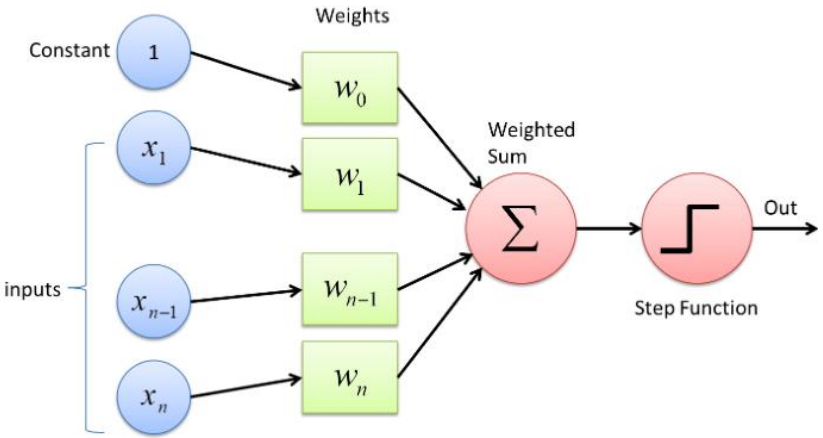
Machine Learning vs Deep Learning



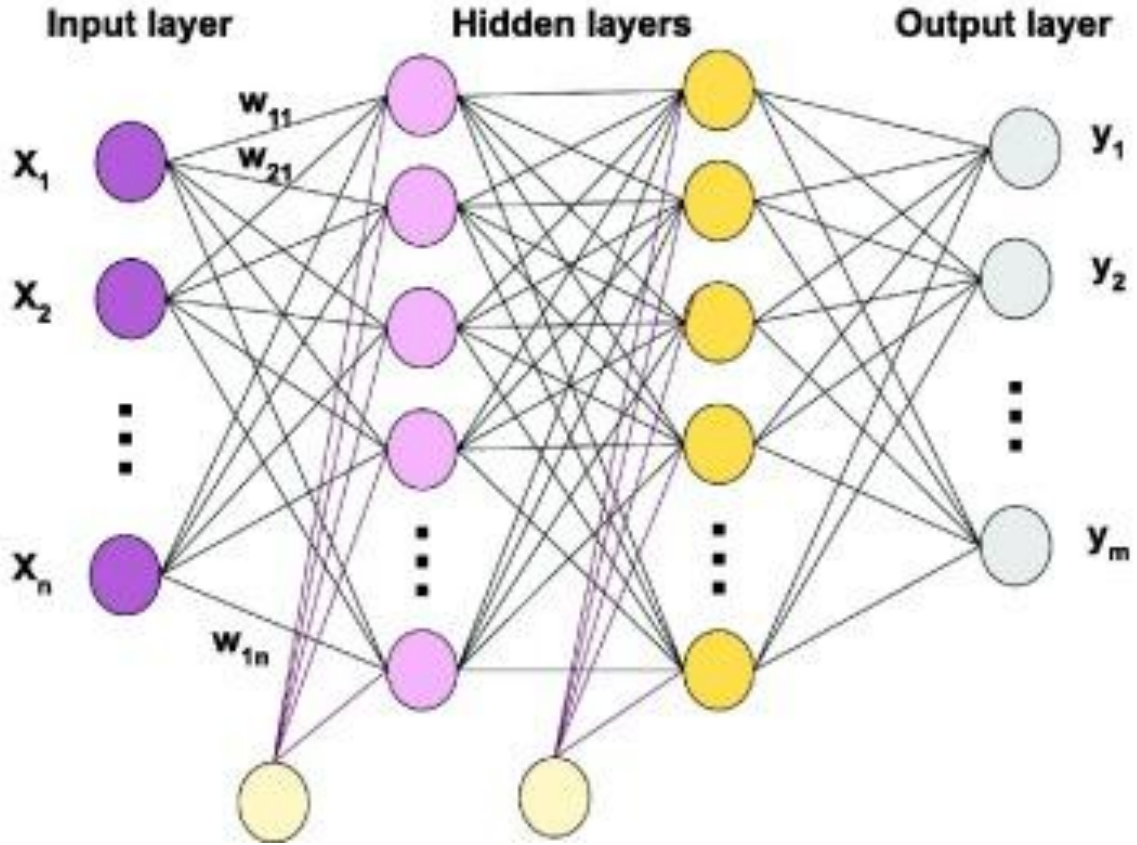
Neural Networks
What are neural networks?

Biological neuron vs Artificial neuron



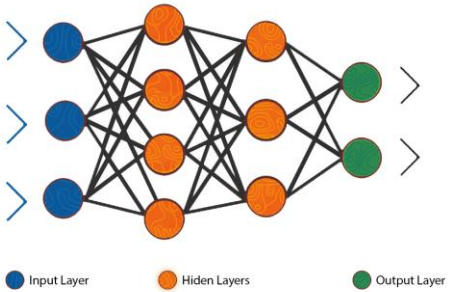


Artificial Neural network

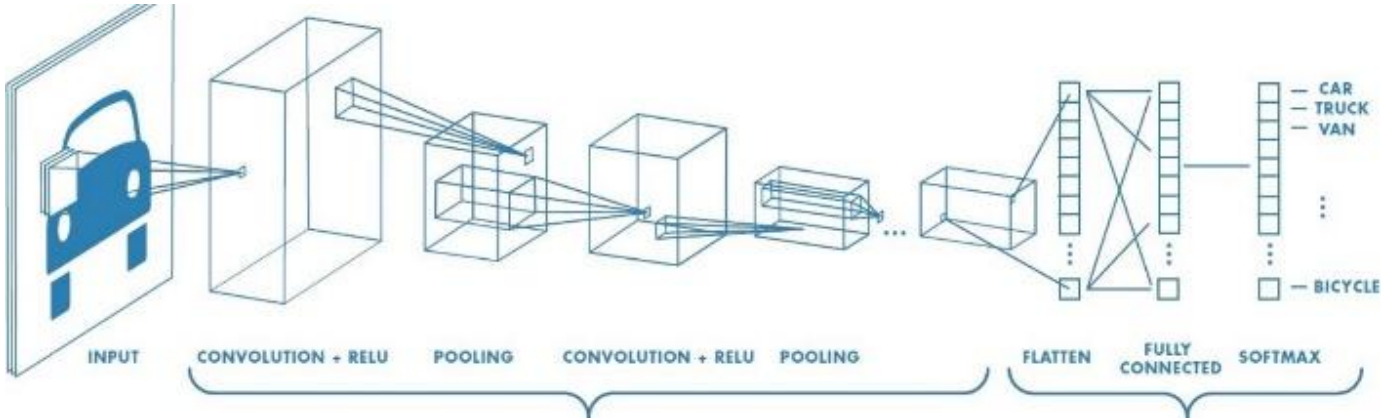


Different types of Neural Network

- Multi Layered Perceptron (MLP)

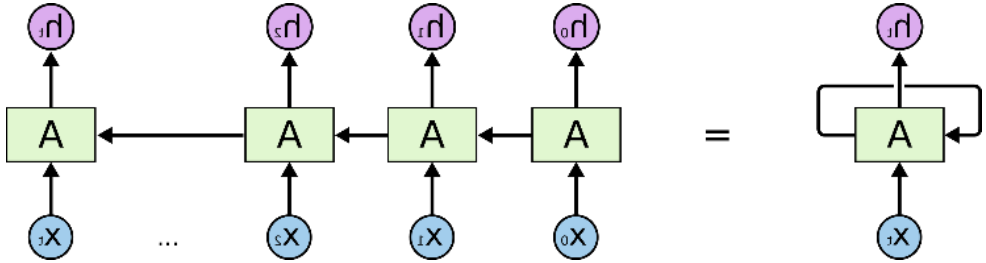


- Convolutional Neural network (CNN)

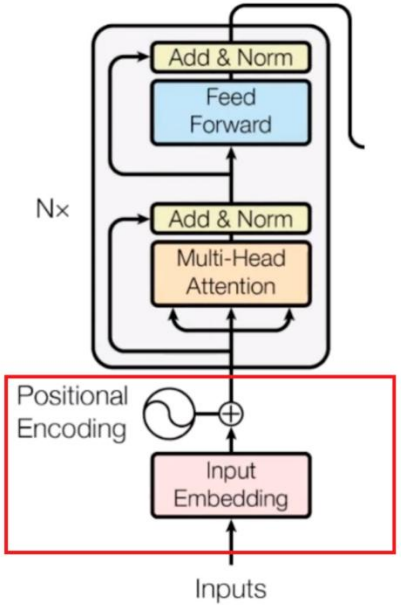


Different types of Neural Network

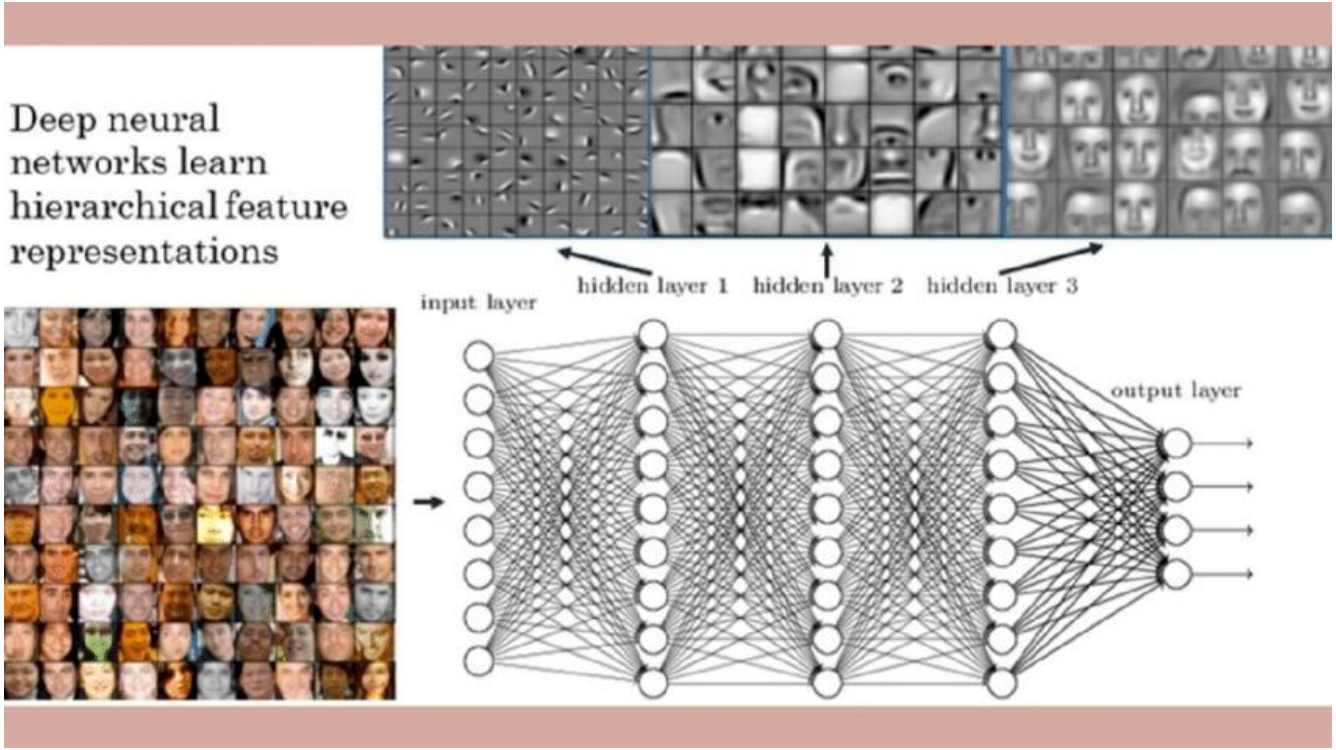
- Recurrent Neural network (RNN)



- Transformer Neural network



Deep Neural networks learn hierarchical features



IMAGENET Large Scale Visual Recognition Challenge

The Image Classification Challenge:
1,000 object classes
1,431,167 images

Output:
Scale
T-shirt
<u>Steel drum</u>
Drumstick
Mud turtle

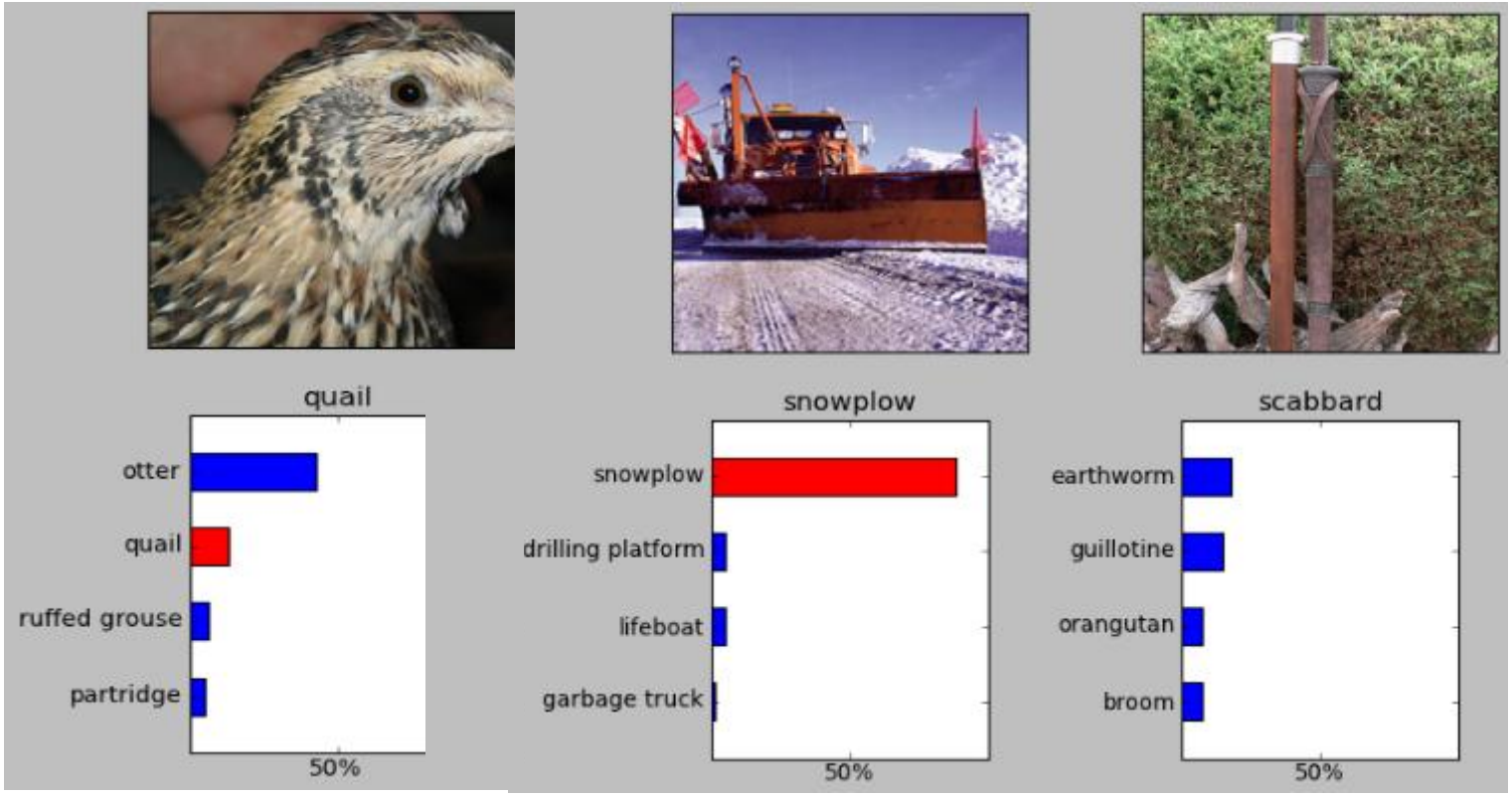
✔

Output:
Scale
T-shirt
Giant panda
Drumstick
Mud turtle

✗

Russakovsky et al. IJCV 2015

Object Recognition



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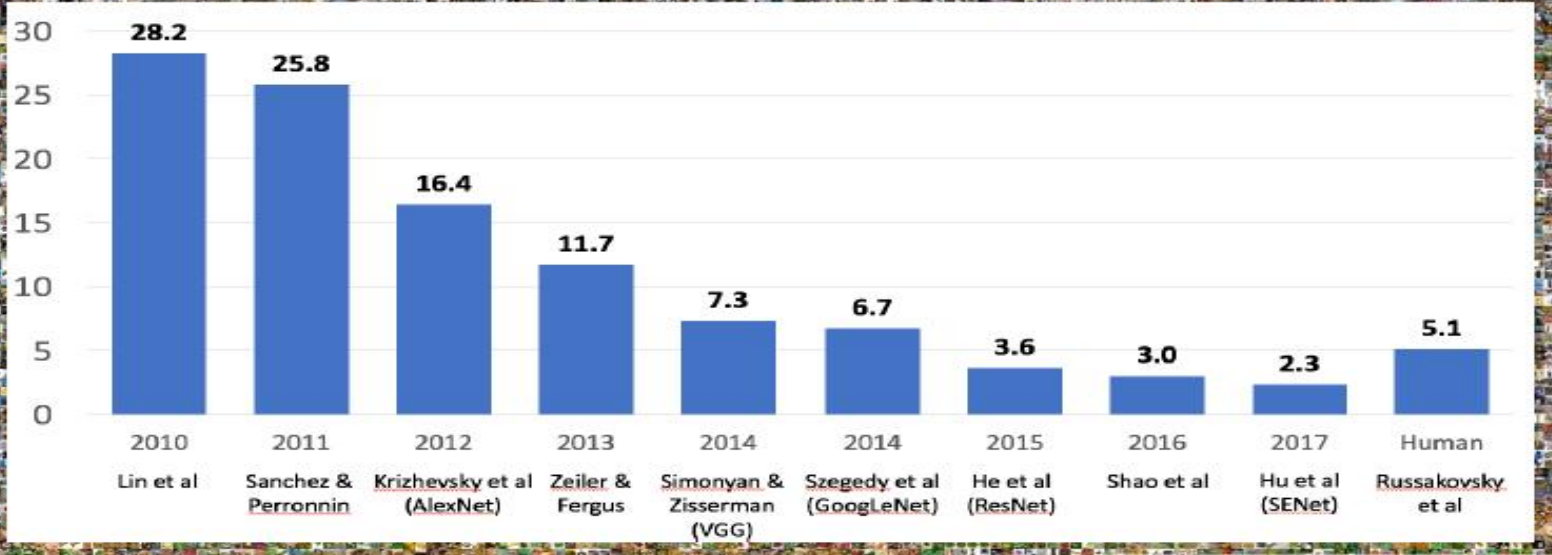
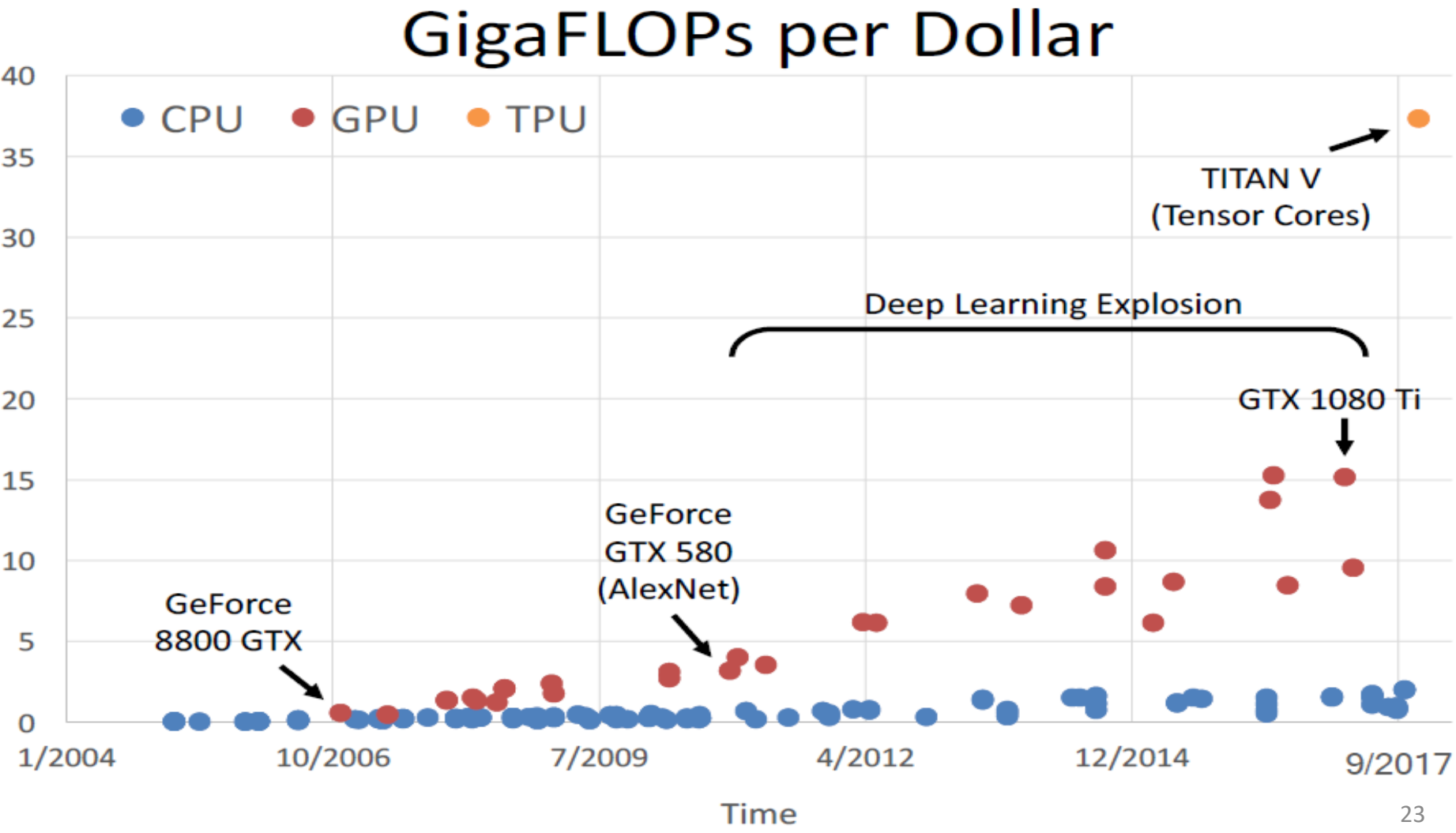
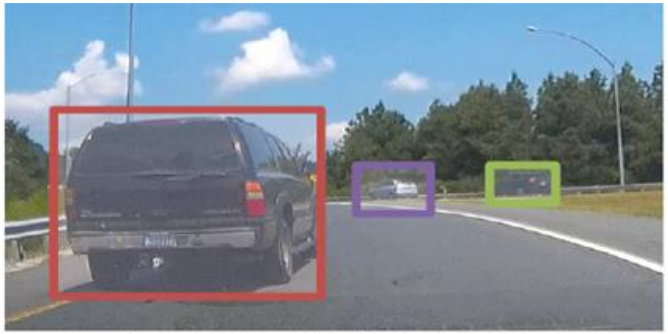


Russakovsky et al. IJCV 2015


GigaFLOPs per Dollar
CPU
GPU
TPU
TITAN V
(Tensor Cores)
Deep Learning Explosion
GTX 1080 Ti
GeForce
GTX 580
(AlexNet)
GeForce
8800 GTX
40
35
30
25
20
15
10
5
0
1/2004
10/2006
7/2009
4/2012
12/2014
9/2017
Time

Object Detection



Person

Hammer

Neural style transfer


Content Style

Generated image


Content Style

Generated image

[Images generated by Justin Johnson]

Image Captioning: Example Results

Captions generated using neuraltalk2
All images are CC0 Public domain:
cat suitcase, cat tree, dog, bear,
surfers, tennis, giraffe, motorcycle

A cat sitting on a suitcase on the floor

A cat is sitting on a tree branch

A dog is running in the grass with a frisbee

A white teddy bear sitting in the grass

Two people walking on the beach with surfboards

A tennis player in action on the court

Two giraffes standing in a grassy field

A man riding a dirt bike on a dirt track

Visual Question Answering

Q: What endangered animal is featured on the truck?

A: **A bald eagle.**
A: A sparrow.
A: A humming bird.
A: A raven.

Q: Where will the driver go if turning right?

A: **Onto 24 ¾ Rd.**
A: Onto 25 ¾ Rd.
A: Onto 23 ¾ Rd.
A: Onto Main Street.

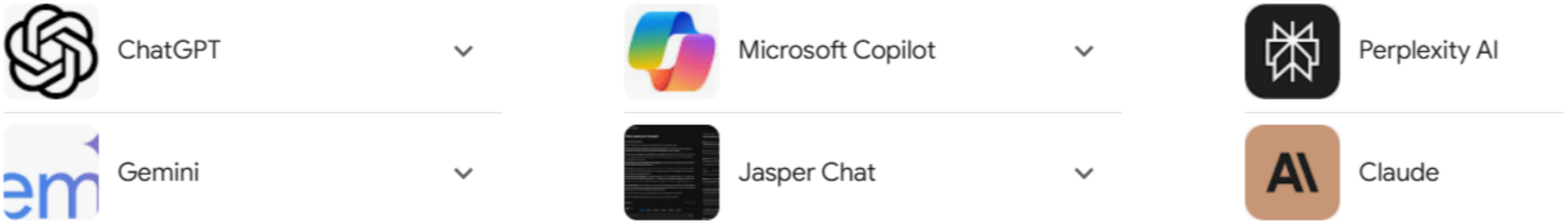
Q: Who is under the umbrella?

A: **Two women.**
A: A child.
A: An old man.
A: A husband and a wife.

Agrawal et al, "VQA: Visual Question Answering", ICCV 2015
Zhu et al, "Visual 7W: Grounded Question Answering in Images", CVPR 2016
Figure from Zhu et al, copyright IEEE 2016. Reproduced for educational purposes.

Natural Language Processing (NLP)

Text Generation
Chat bot



Natural Language Processing (NLP)

Sentiment classification problem

	x	y
The dessert is excellent.		
Service was quite slow.		
Good for a quick meal, but nothing special.		
Completely lacking in good taste, good service, and good ambience.		

Image generation with GAN

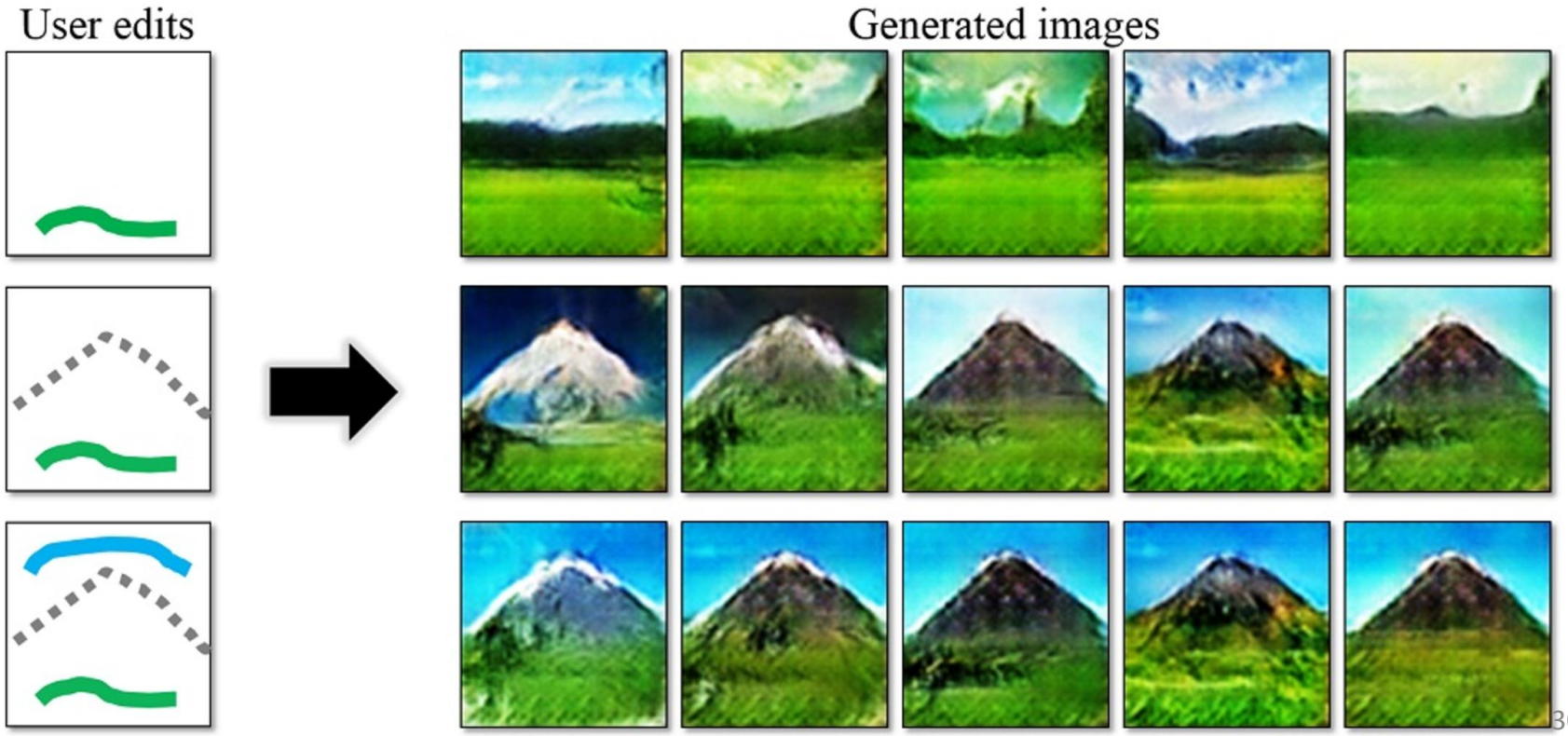


Image Super resolution with GAN

Which one is Computer generated?



Text-to-Image Synthesis with GAN

Motivation

Given a text description, generate images closely associated.

Uses a conditional GAN with the generator and discriminator being condition on “dense” text embedding.

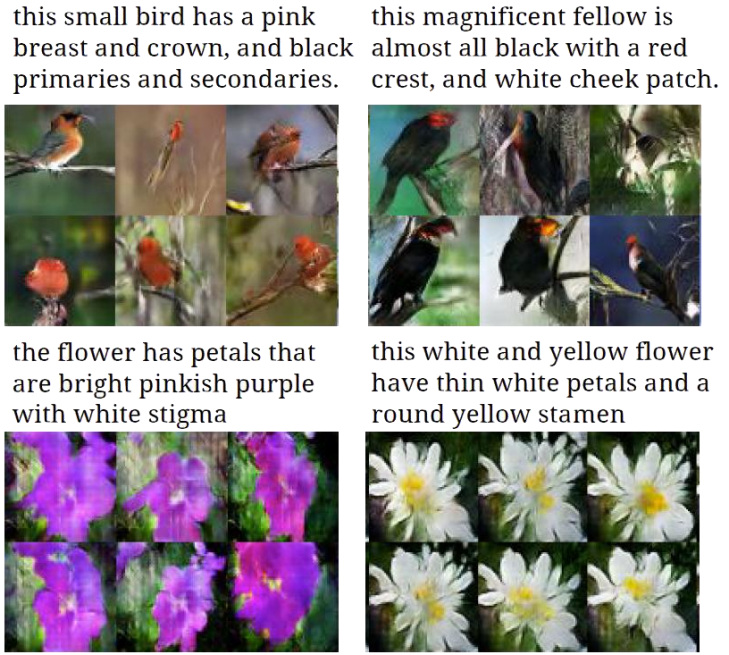


Figure 1 in the original paper.

Generated face images with NVAE

NVAE: A Deep Hierarchical Variational Autoencoder

Image-to-Image Translation with GAN

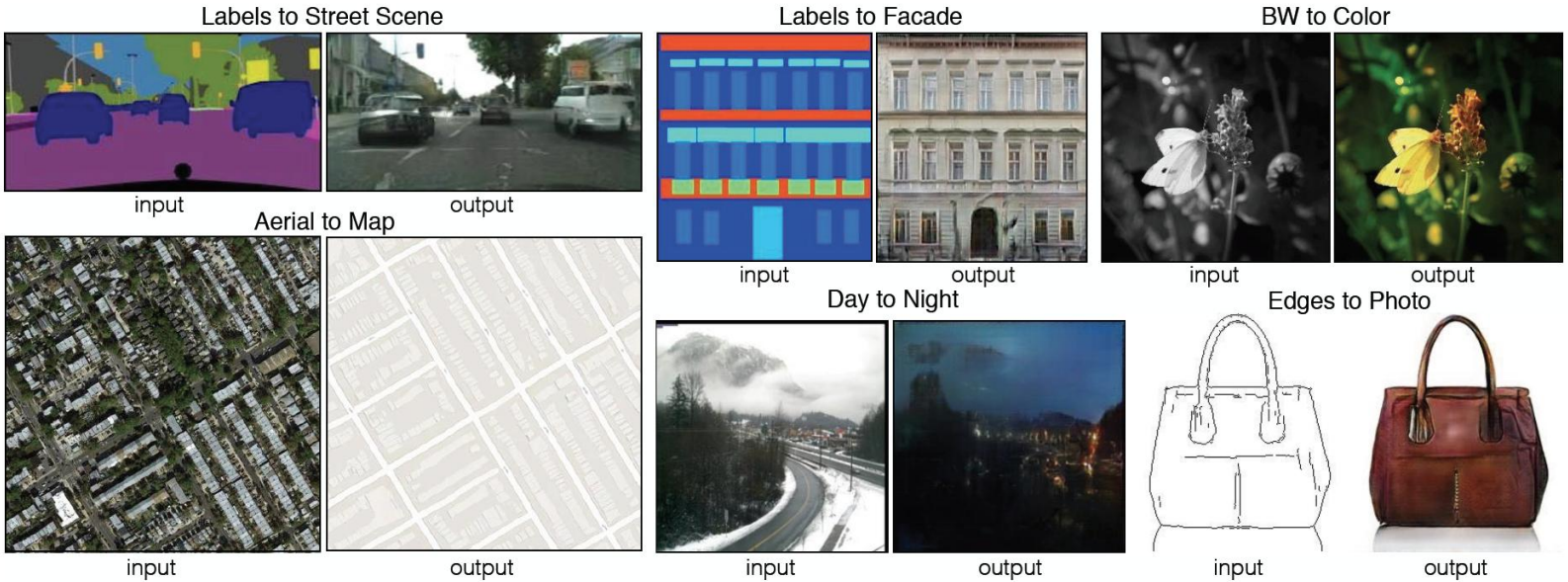


Figure 1 in the original paper.

[Link to an interactive demo of this paper]

Bs. Related Courses and Laboratories in

- Artificial intelligence
- Principle of Computational Intelligence
- Principle of Machine Learning
- Principle of Data mining
- Machine Learning with graph
- Principle of Computer vision
- Neural Network
- Multimedia

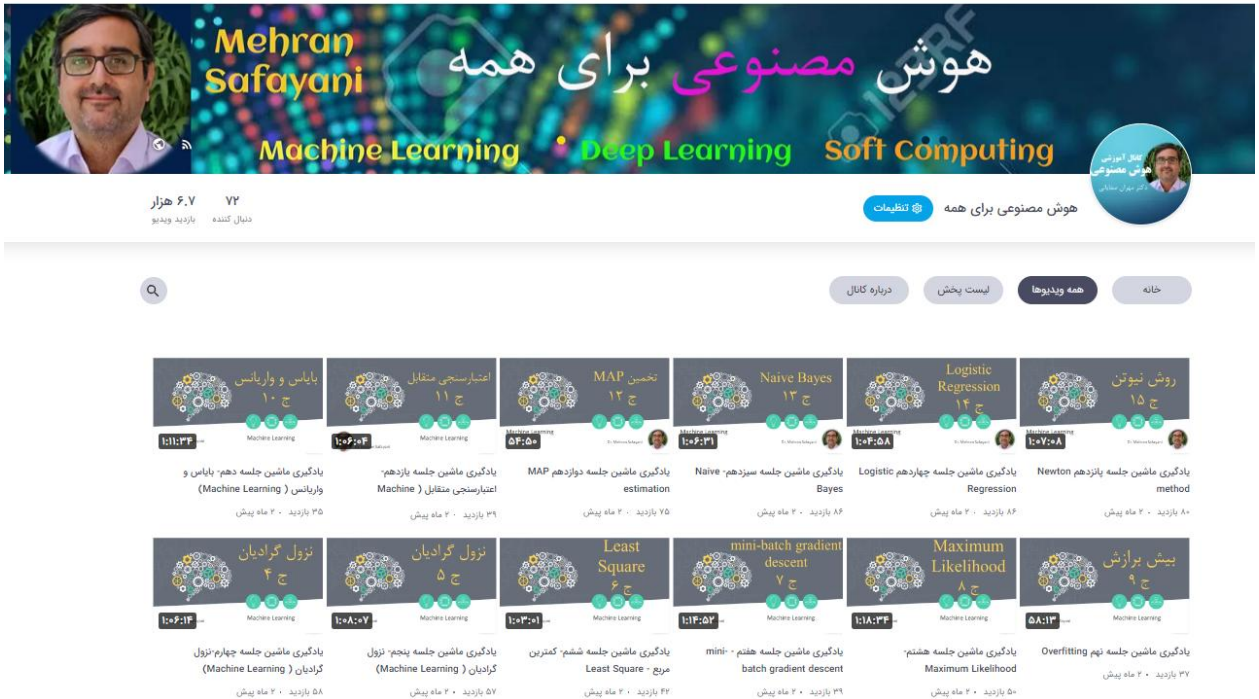
- Computational Intelligence Lab

Ms. Related Courses in

- Machine Learning
- Deep Learning
- Neural network
- Pattern recognition
- Data mining
- Computer vision
- Reinforcement Learning
- probabilistic graphical models
- complex network
- Advanced multimedia
- Cloud computing
- …

- Image-to-Image Demo (pix2pix)
- this-person-does-not-exist (style GAN)
- GANSketching
- GAN PAINT
- بلبل زبان
- Generating MUSIC
- Style transfer

برای دریافت آموزش های بیشتر در حوزه یادگیری عمیق و یادگیری ماشین کانال زیر را دنبال کنید:



https://www.aparat.com/mehran.safayani

لینک به ویدئو سال گذشته در آپارات

Andrew Ng