Machine learning

AI

ML

DL

Artificial Intelligence
A program that can sense, reason, act and adapt

Machine Learning
Algorithms that learn from data

Deep Learning
Multilayered artificial neural networks trained on big data

DL

CNN

RNN

RL

Deep Learning
Multilayered artificial neural networks trained on big data

Convolution NN
Tackles computer vision problems

Recurrent NN
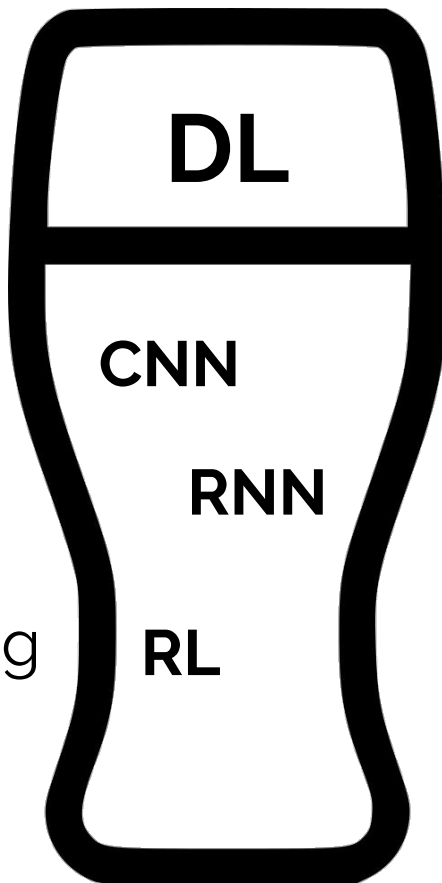Tackles data series problems

Reinforcement Learning
Tackles reward driven environment exploration and navigation problems

Supervised vs unsupervised learning

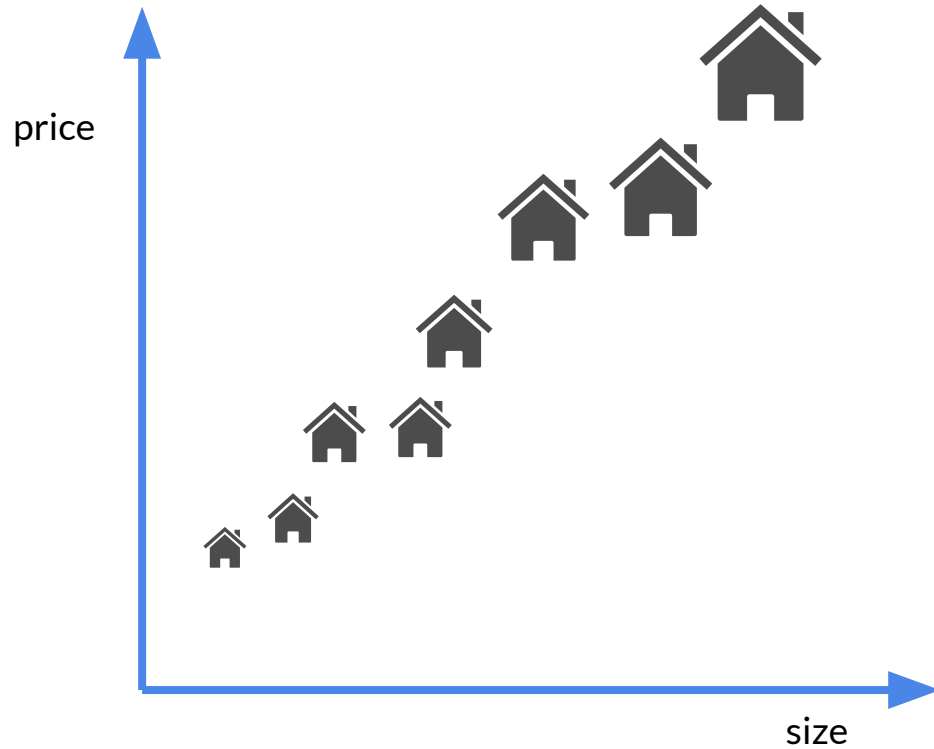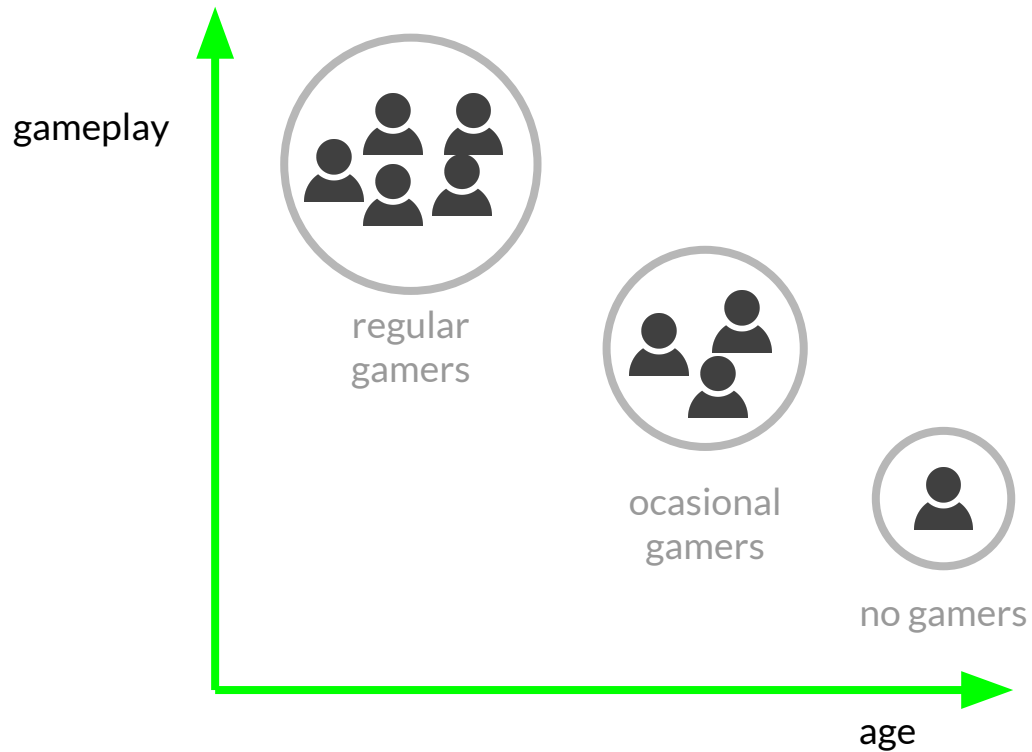| SUPERVISED	UNSUPERVISED
classification	clustering
regression	reinforcement learning

labels

no labels

Classification
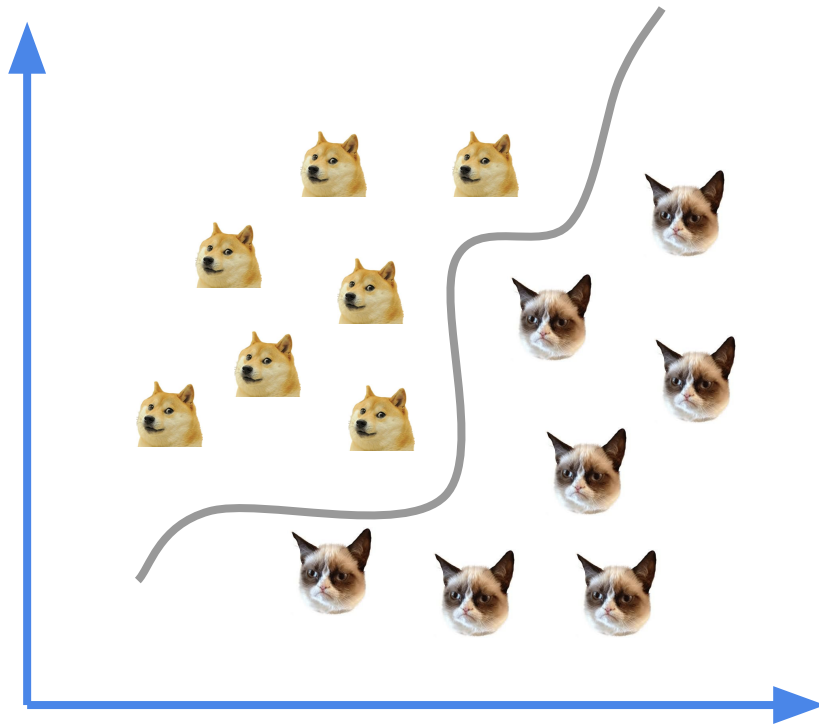
Regression

Clustering
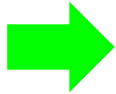
gameplay

regular
gamers

ocasional
gamers

no gamers

age

From traditional machine learning …
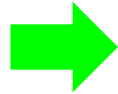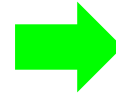
foam
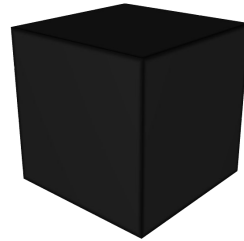colour
glass
…

"features"   classifier

... to deep learning

foam
colour
glass
...
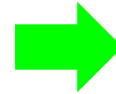
"features"   classifier
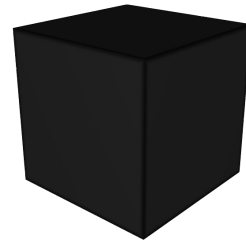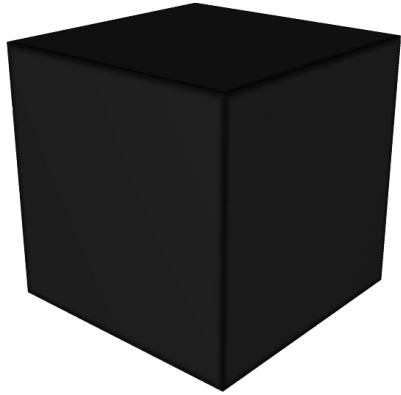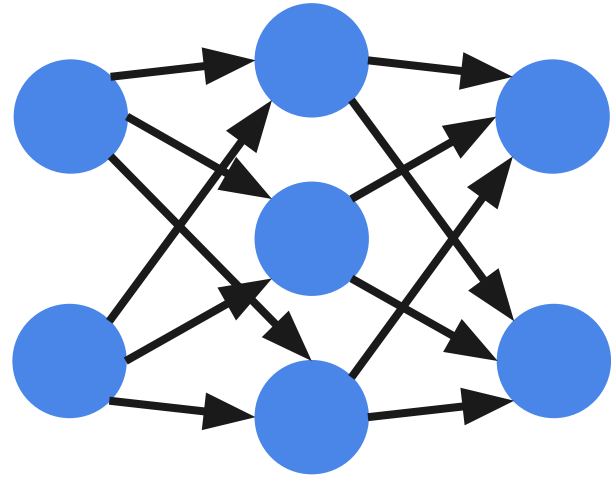
Unboxing the box full of *neurons*

==

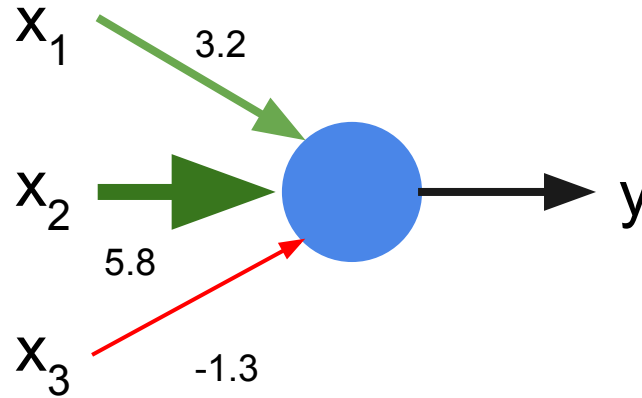Artificial Neural Network (ANN)*

Neuron - inputs & outputs

x_1

x_2

x_3

y

OUTPUT

INPUTS

Neuron - weights

x_1 3.2

x_2 y

5.8

x_3 -1.3
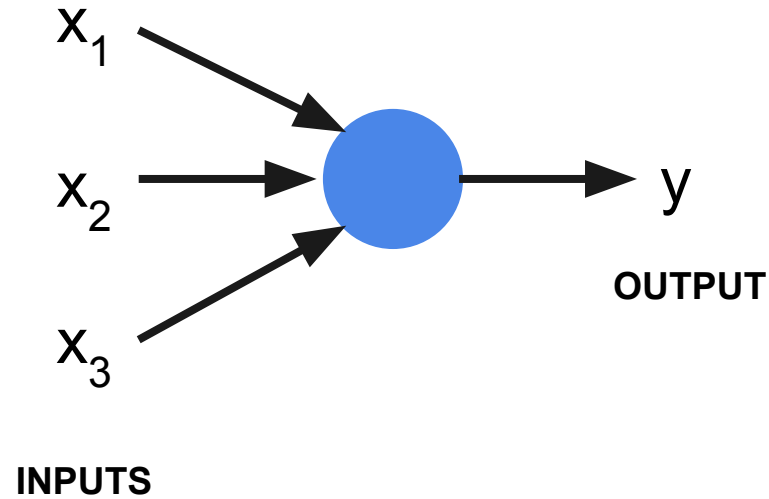
WEIGHTS

Neuron - sum (∑) & activation (g)

activations

$\sigma(z) = \frac{1}{1 + e^{-z}}$

sigmoid

$R(z) = max(0, \ z)$

ReLU

x_1

w_1

x_2

w_2

x_3

w_3

$g(\sum)$

y
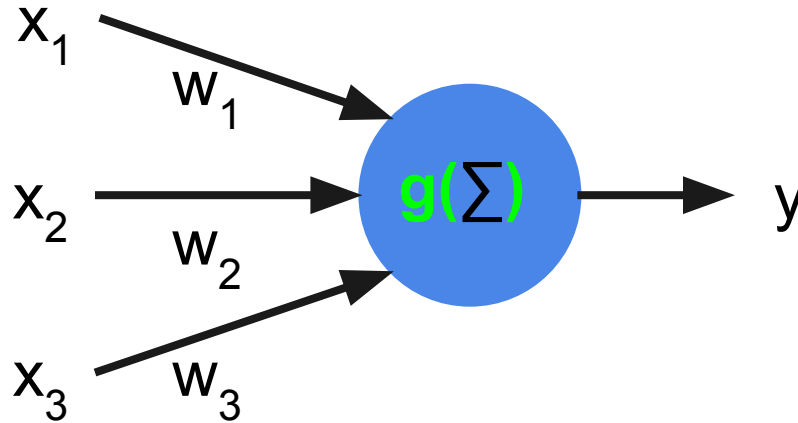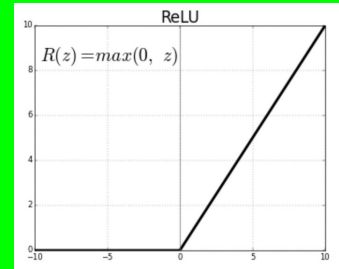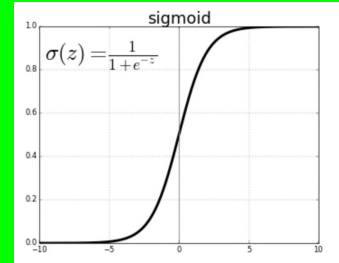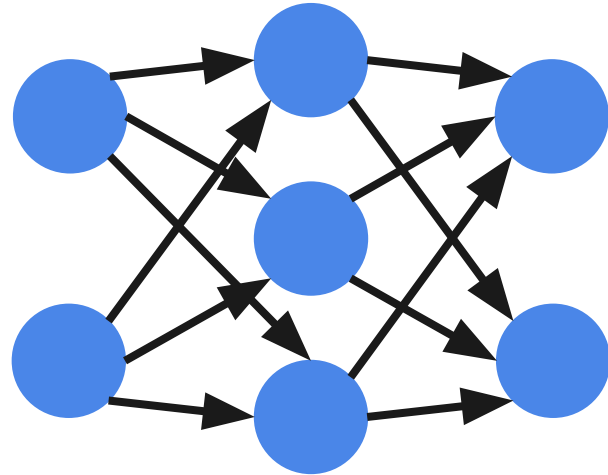
Training procedure

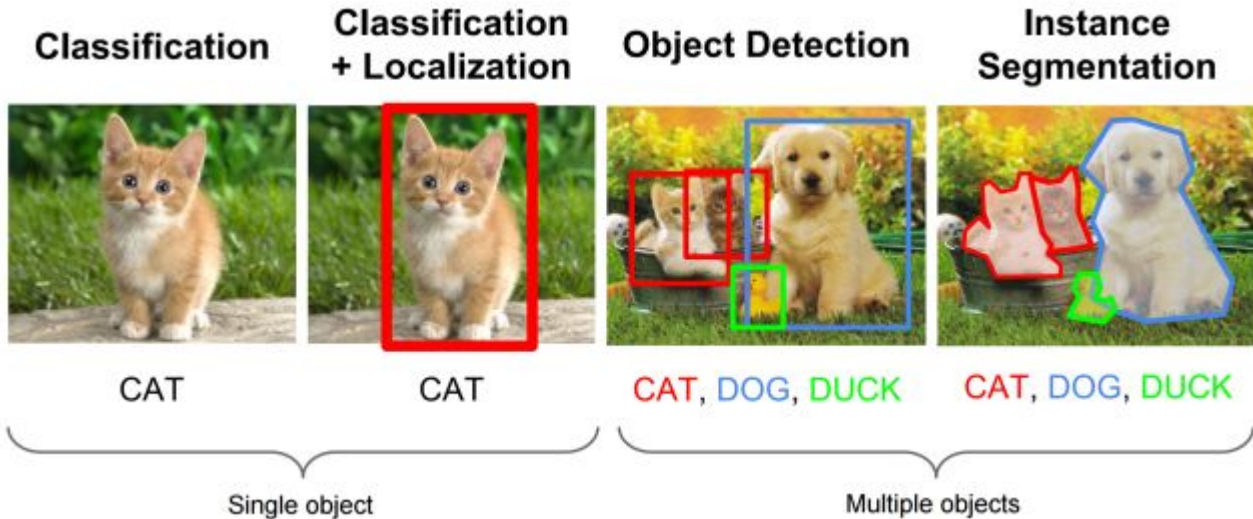1. Init weights
2. Feed forward
3. Calculate **error**
4. Update weights
5. Go to step 2

Applications

What can be done with it?

Classification	Classification + Localization	Object Detection	Instance Segmentation
CAT	CAT	CAT, DOG, DUCK	CAT, DOG, DUCK
Single object		Multiple objects	

What can be done with it?

Sky Building Road Sidewalk Fence Vegetation Pole Car Sign Pedestrian Cyclist

What can be done with it?

Monet ⇄ Photos   Zebras ⇄ Horses   Summer ⇄ Winter

Monet → photo   zebra → horse   summer → winter

photo → Monet   horse → zebra   winter → summer

Photograph   Monet   Van Gogh   Cezanne   Ukiyo-e

What can be done with it?

Source: https://www.youtube.com/watch?v=YGO2IwAgrig
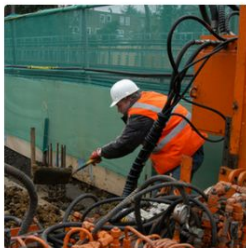
What can be done with it?

"man in black shirt is playing guitar."

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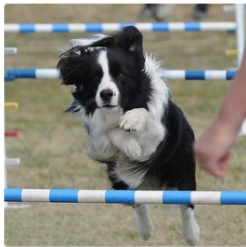

"two young girls are playing with lego toy."

"boy is doing backflip on wakeboard."

"girl in pink dress is jumping in air."
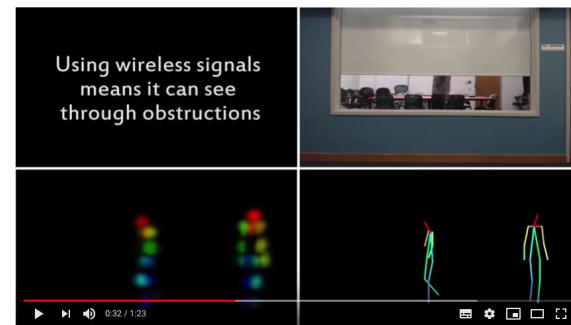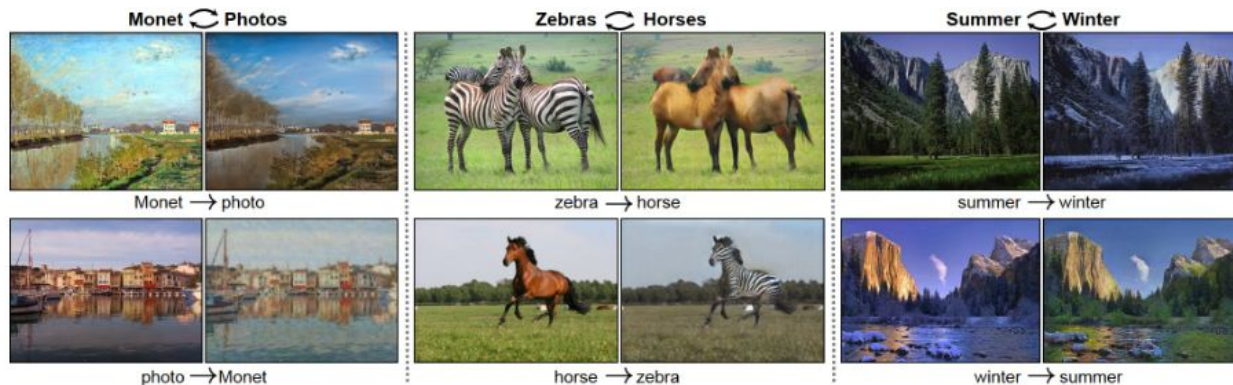

"black and white dog jumps over bar."

"young girl in pink shirt is swinging on swing."

"man in blue wetsuit is surfing on wave."

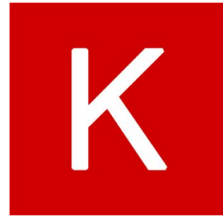# What can be done with it?

Getting started

What is required?

1. Knowledge of Python ✓
2. Data
3. Data
4. Data ☹
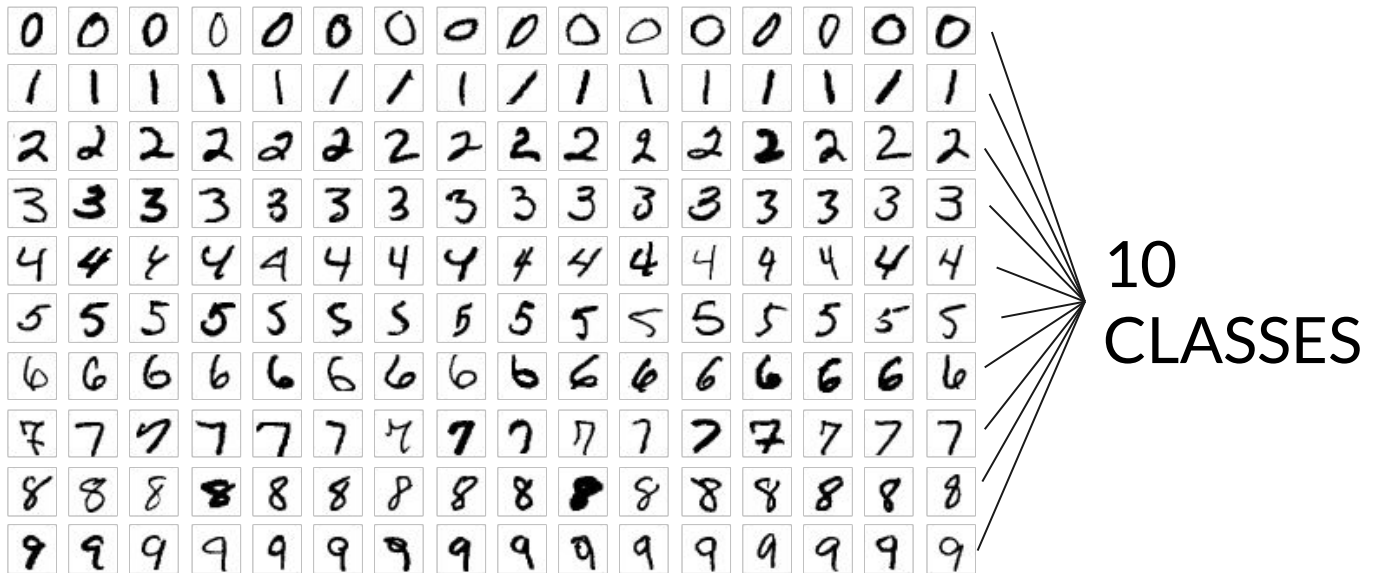5. Ph.D. from statistics ✗

Machine learning frameworks

MNIST example

MNIST example
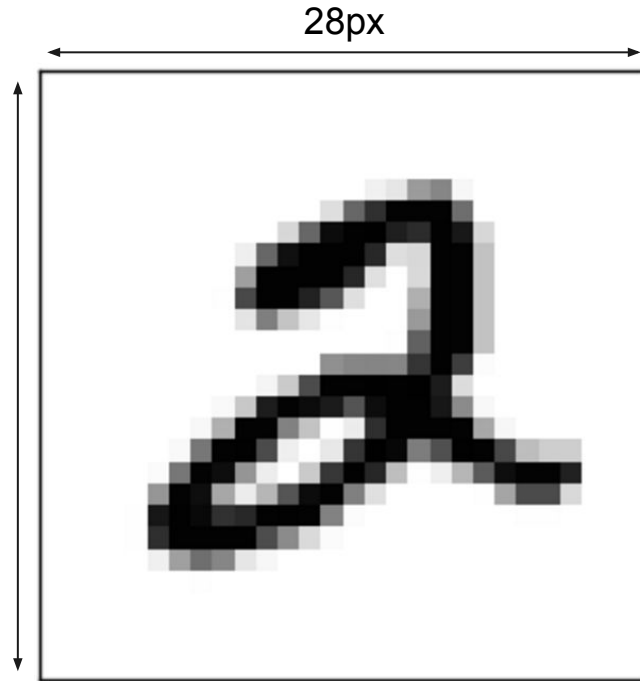

10
CLASSES
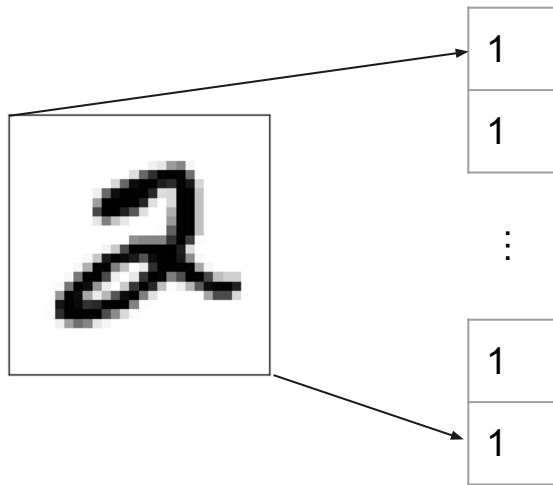
MNIST example

28px

768px (inputs)

28px

MNIST example

768 inputs

$[W_{768x10}]$
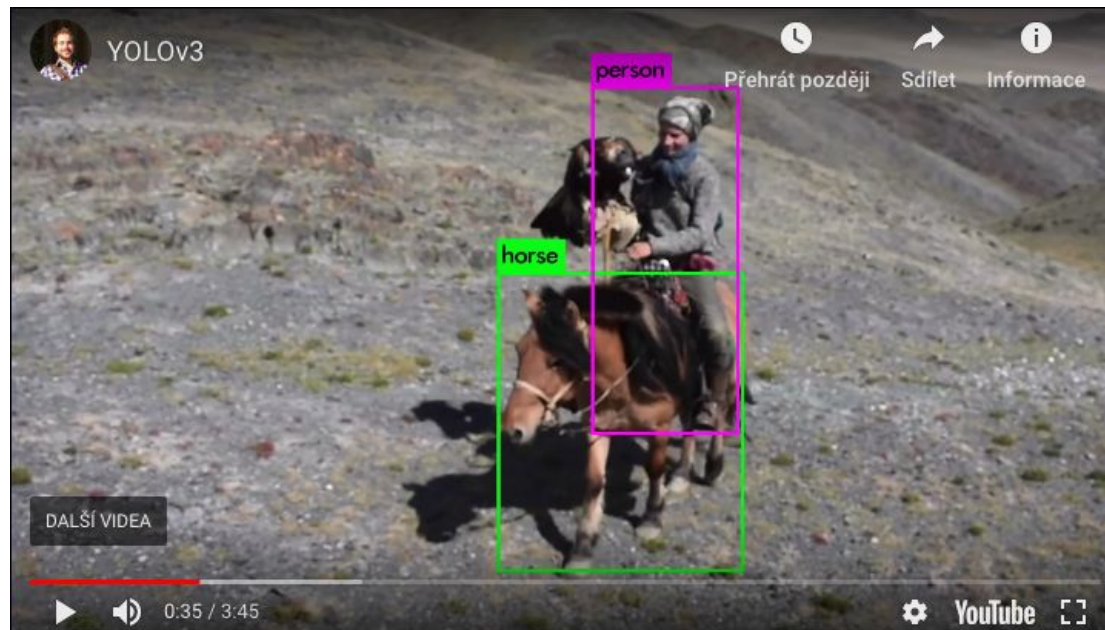
10 CLASSES

YOLO example

YOLO object detection

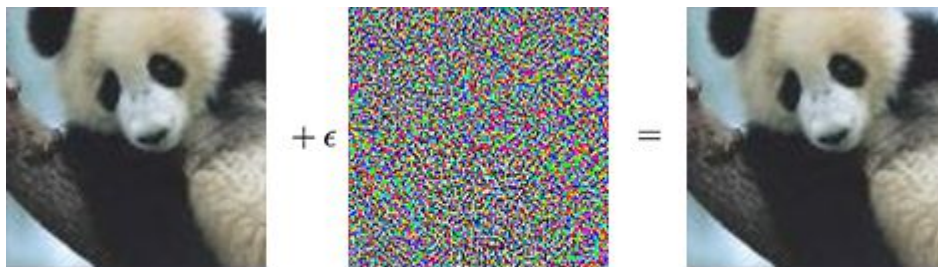# What could possibly go wrong, right?

When it breaks (adversarial inputs)

"panda"
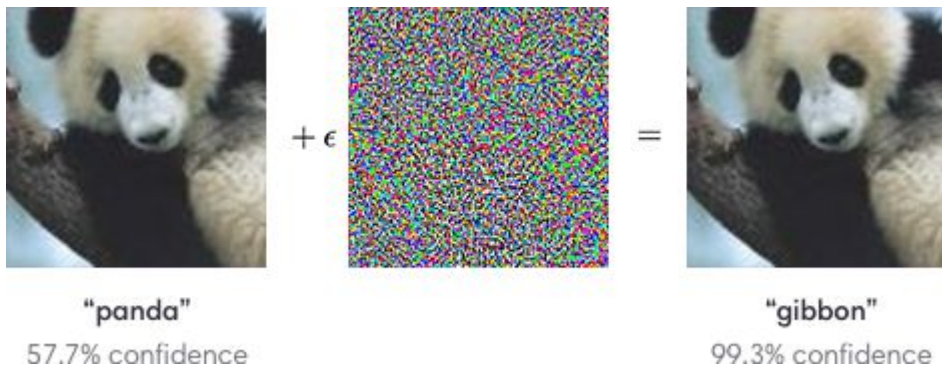57.7% confidence

When it breaks (adversarial inputs)

"panda"
57.7% confidence

When it breaks (adversarial inputs)

"panda"
57.7% confidence

$+\ \epsilon$

$=$

"gibbon"
99.3% confidence

When it breaks (adversarial inputs)

SHIP CAR(99.7%)	
HORSE FROG(99.9%)	
DEER AIRPLANE(85.3%)	
DEER DOG(86.4%)	
HORSE DOG(70.7%)	
DOG CAT(75.5%)	
BIRD FROG(86.5%)	
BIRD FROG(88.8%)	
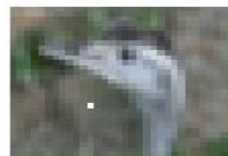
Source: https://blog.openai.com/adversarial-example-research/
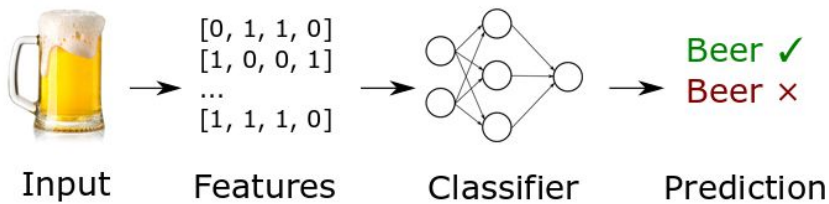
Backup slides

Machine learning

- algorithms learning automatically from (lots of) data

- field exists from the 60's, deep learning popularized in 2012

- outperforms competition in computer vision, language processing, translation, etc.

A change of approach

Traditional machine learning

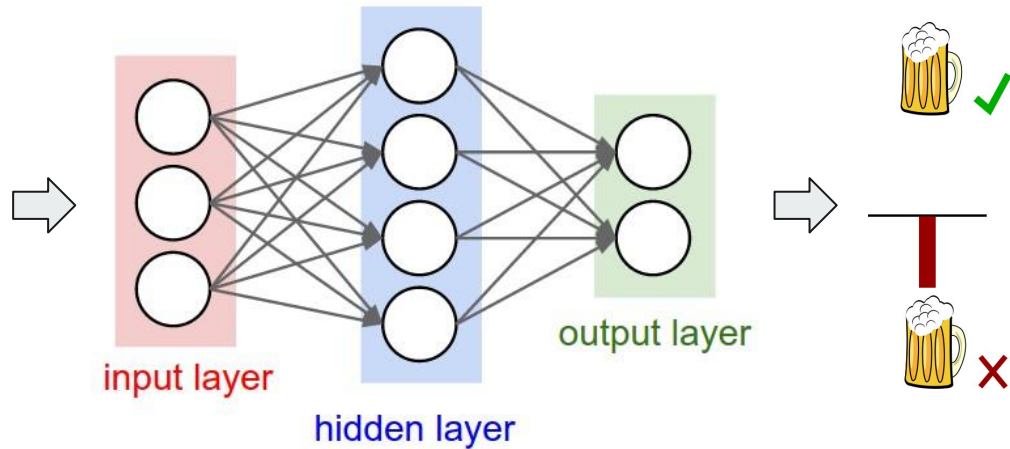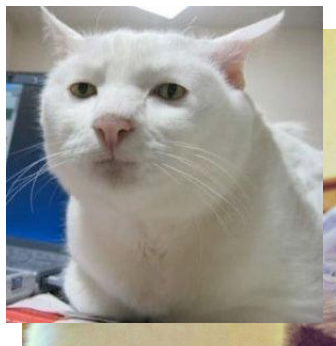| Input | Features | Classifier | Prediction |

Deep learning

| Input | Classifier | Prediction |
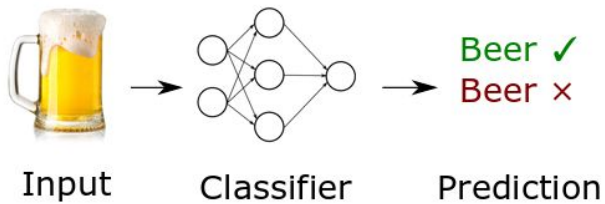
Classification

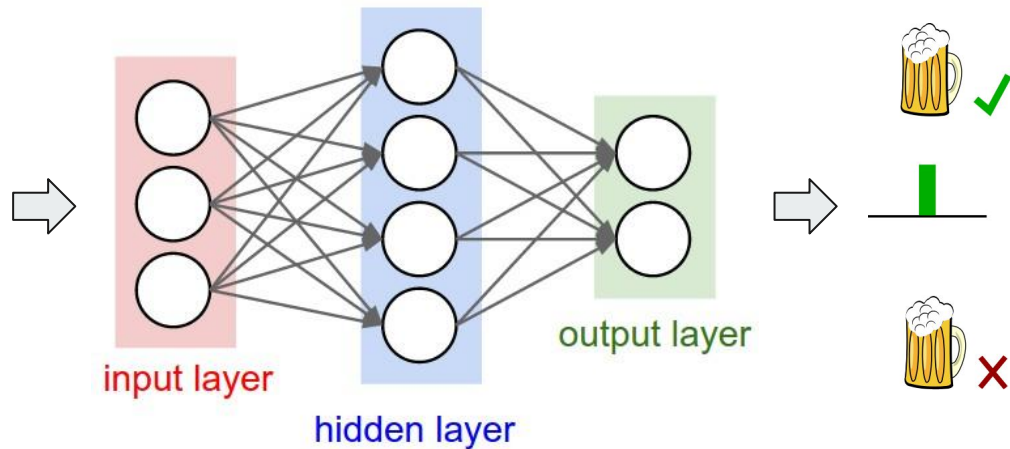- build a model that can classify input data into N classes

1) Get a lot of labeled data
2) Repeatedly present training examples to the classifier
3) Use the trained model for predictions
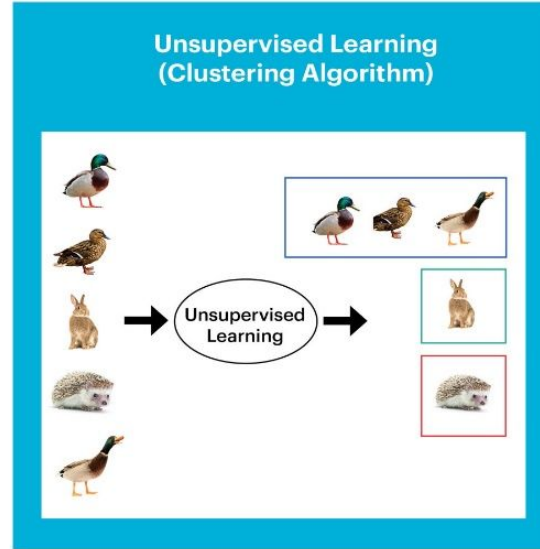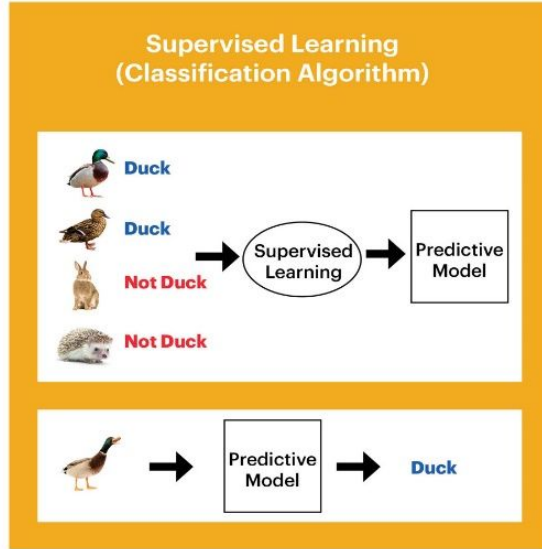
Training

Training

Tensorflow

- open-source Python library from Google for machine learning

- TF computation is defined as a computational graph of math operations

- graph is executed on CPU, GPU or TPU

- low-level API, other libraries use TF as an "assembler" for machine learning

Classification

Tensors.

N-dimensional arrays

Tensors. Flow.

Operations

Tensorflow example

https://github.com/aymericdamien/TensorFlow-Examples/blob/master/examples/3_NeuralNetworks/neural_network_raw.py

Keras

https://github.com/keras-team/keras/blob/master/examples/mnist_mlp.py