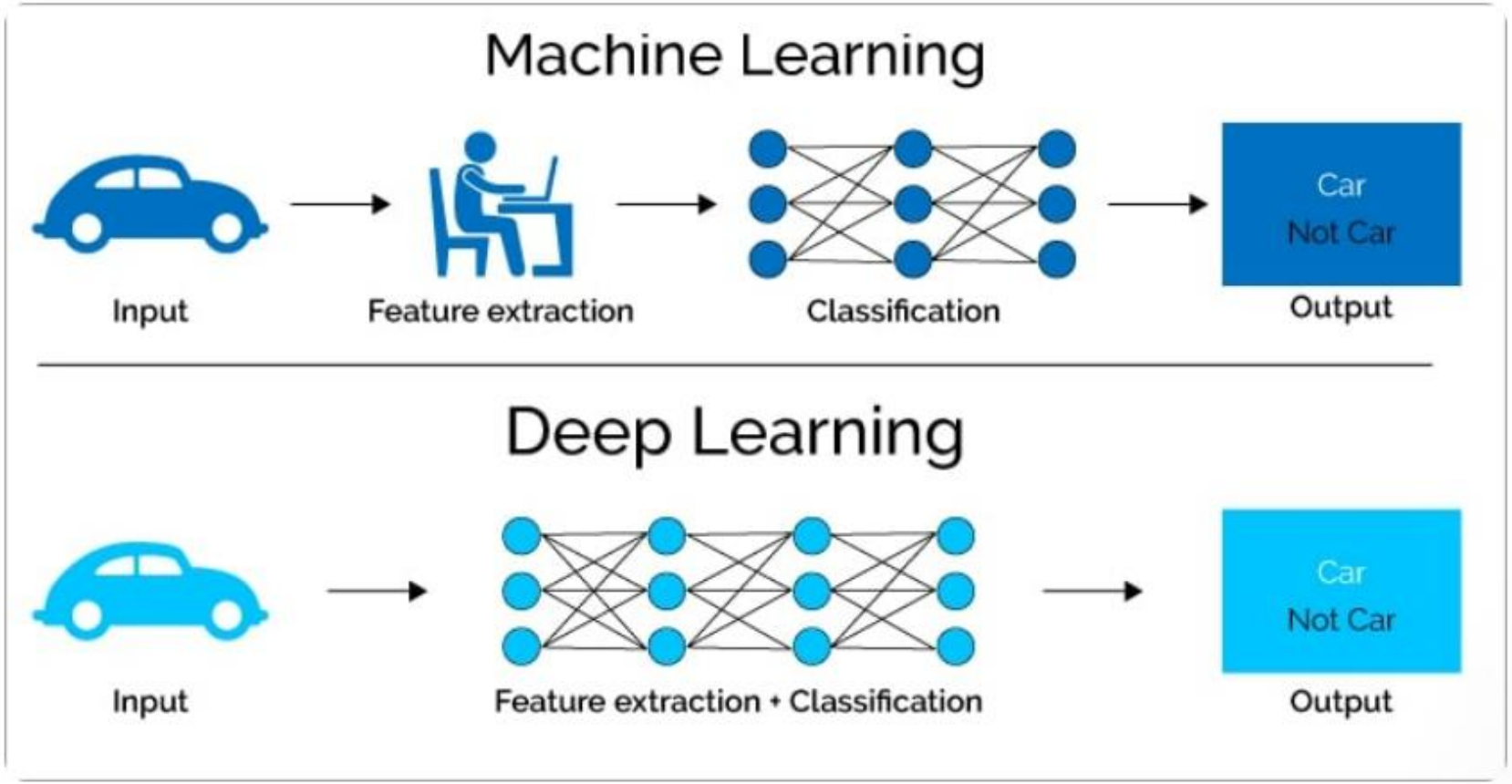
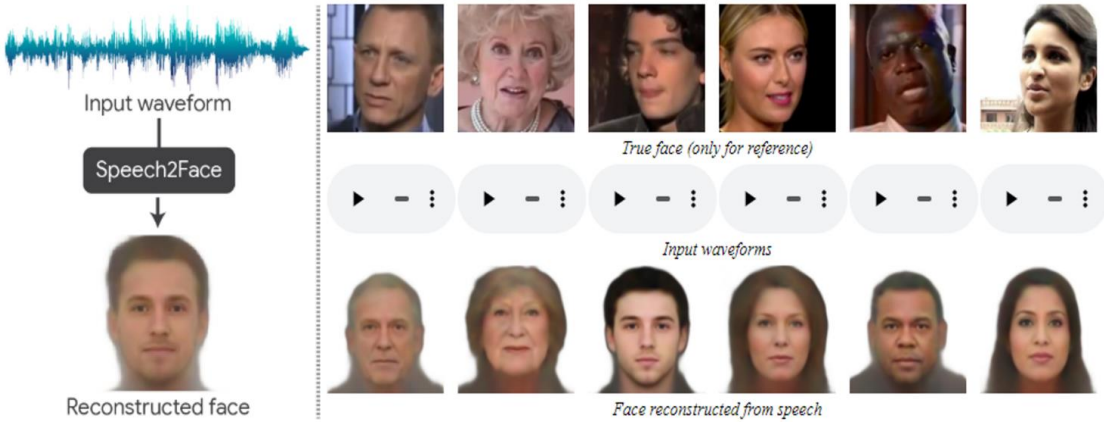
Artificial Intelligence

Intro. to Deep Learning

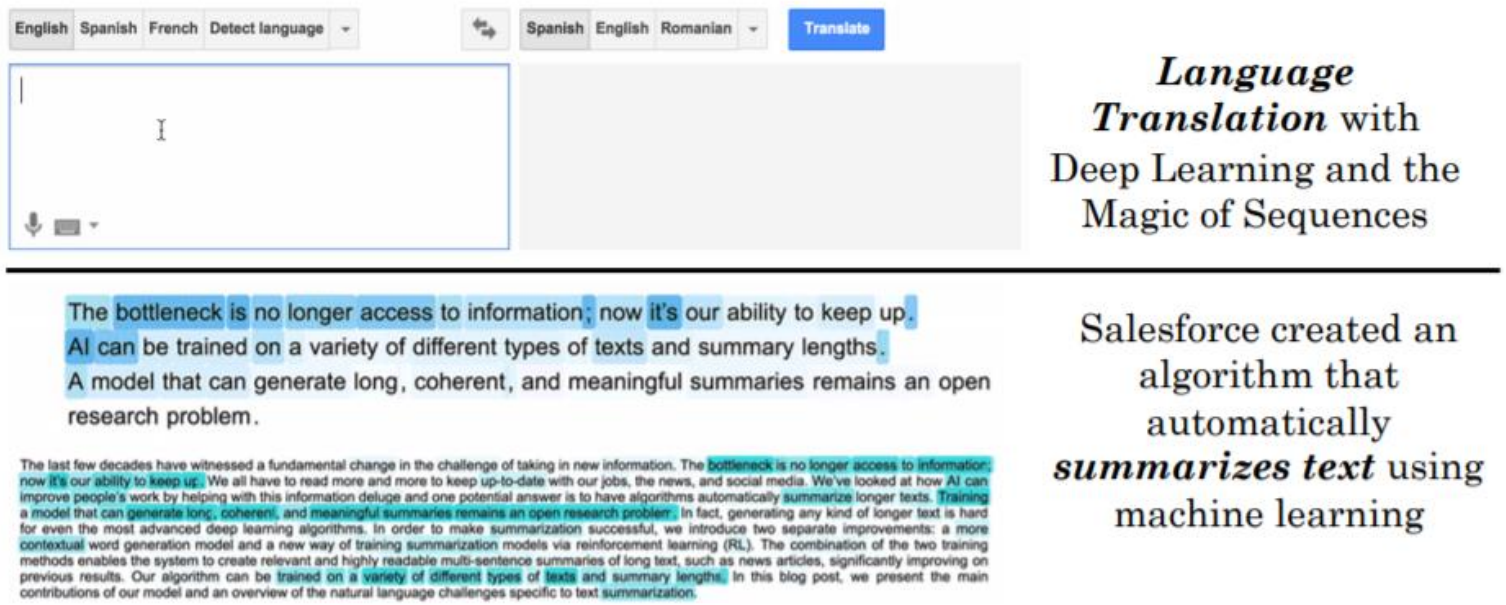
ML vs DL


Machine Learning
Input
Feature extraction
Classification
Car
Not Car
Output
Deep Learning
Input
Feature extraction + Classification
Car
Not Car
Output

Applications



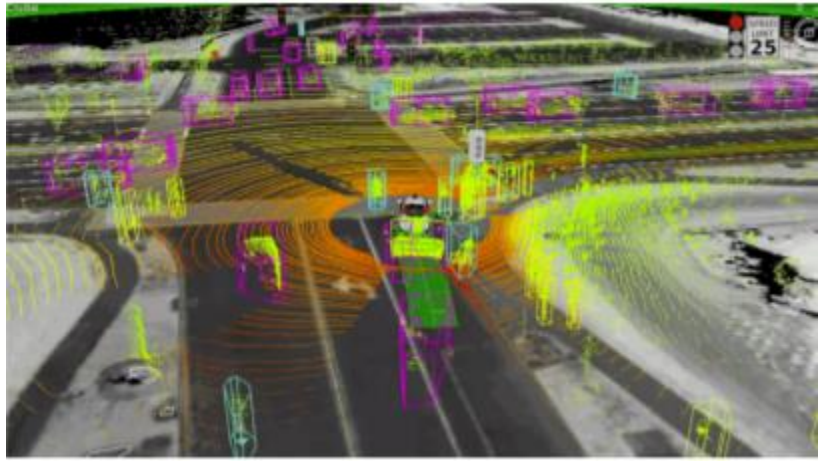
Applications

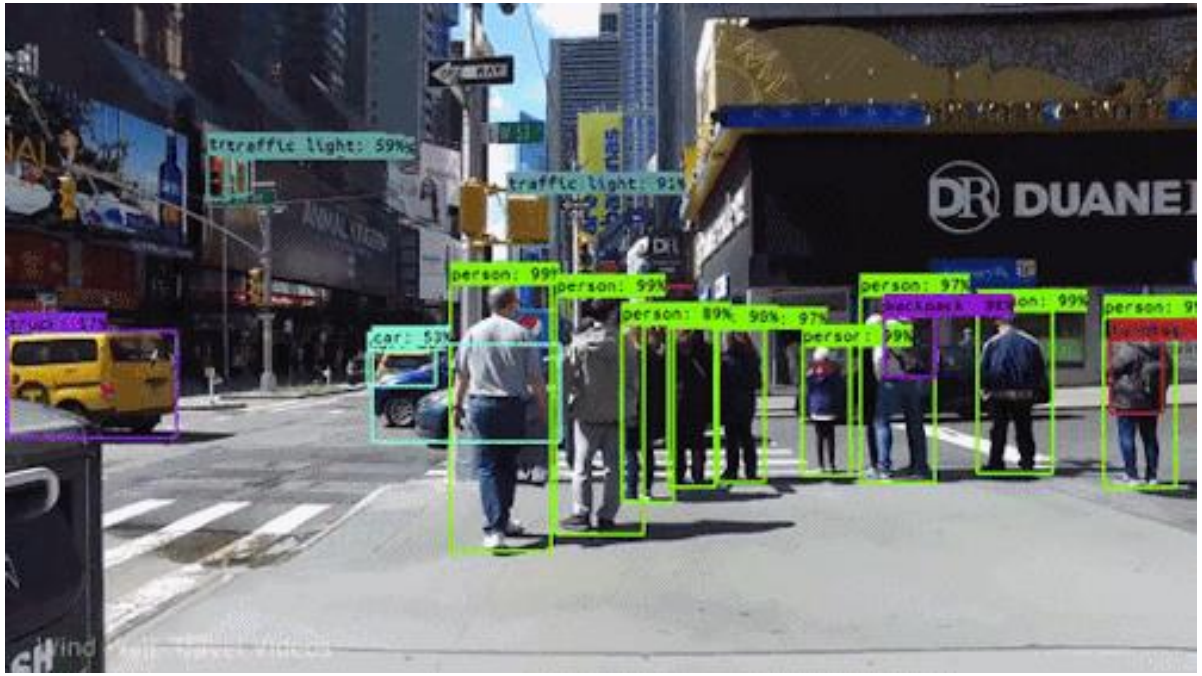


Text Generation/Summarization (NLP)

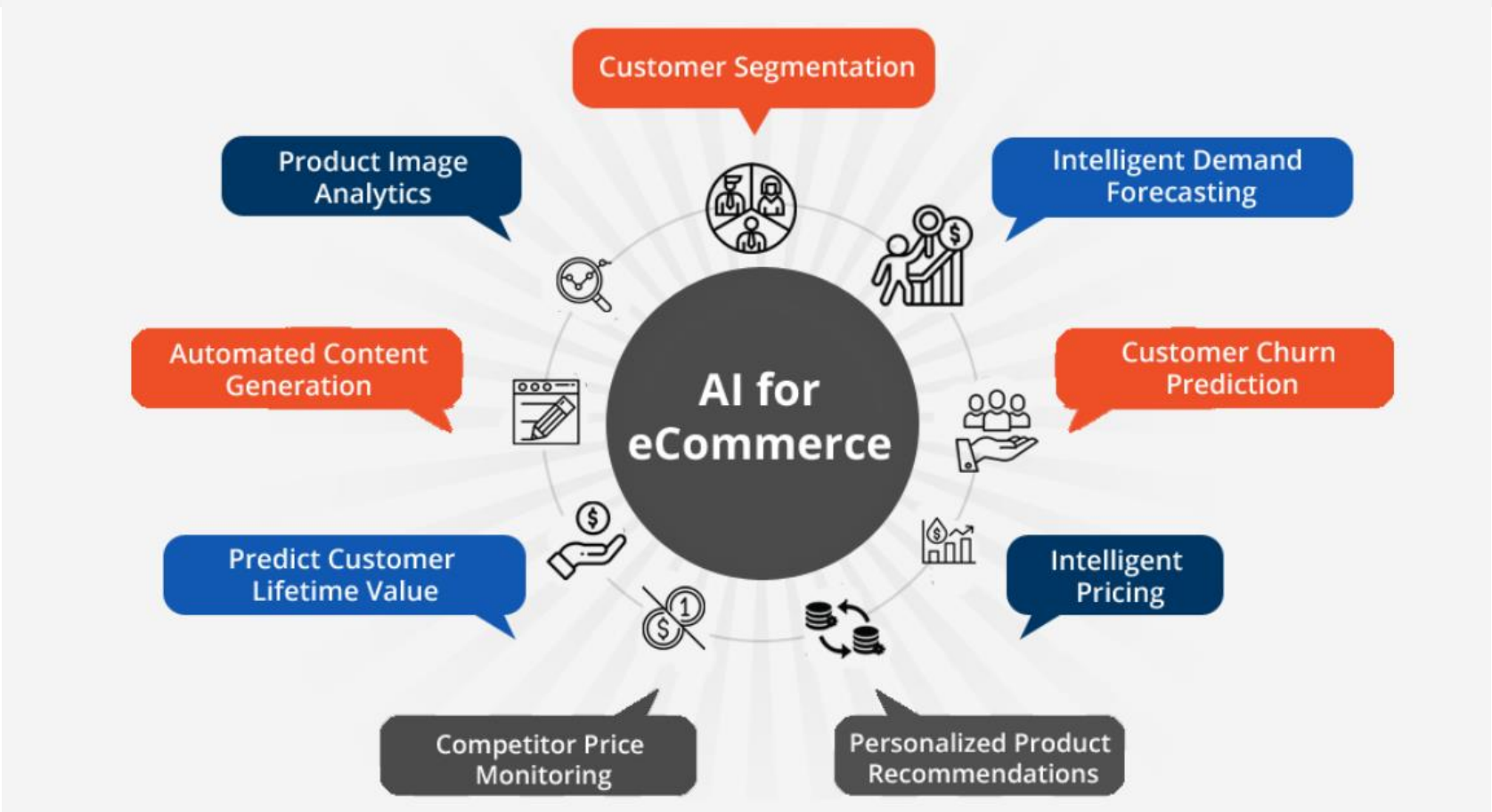
Recommend Movies

Applications: Self Driving Cars





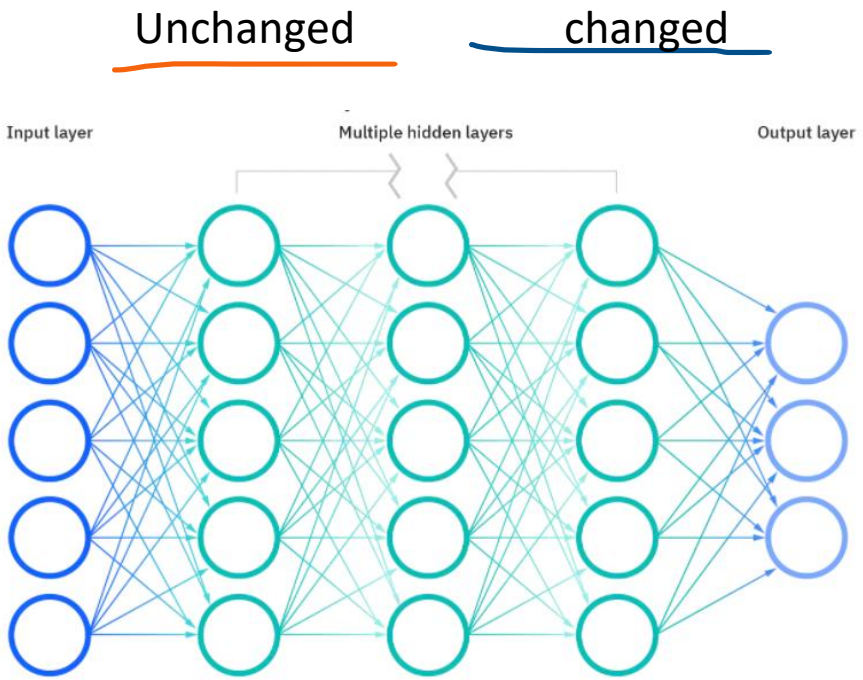
Applications: Ecommerce Websites



Deep Neural Network

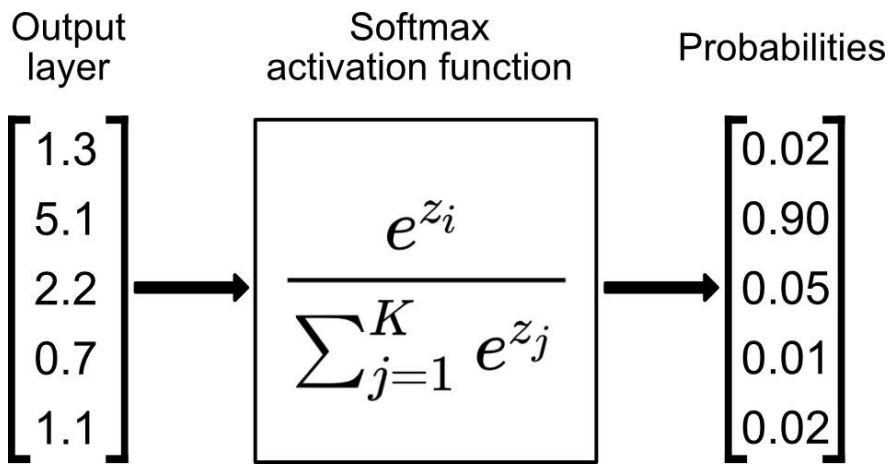
- Any network i.e. Feed Forward or recurrent network with increasing number of hidden layer (>2)
- called Deep Neural Network

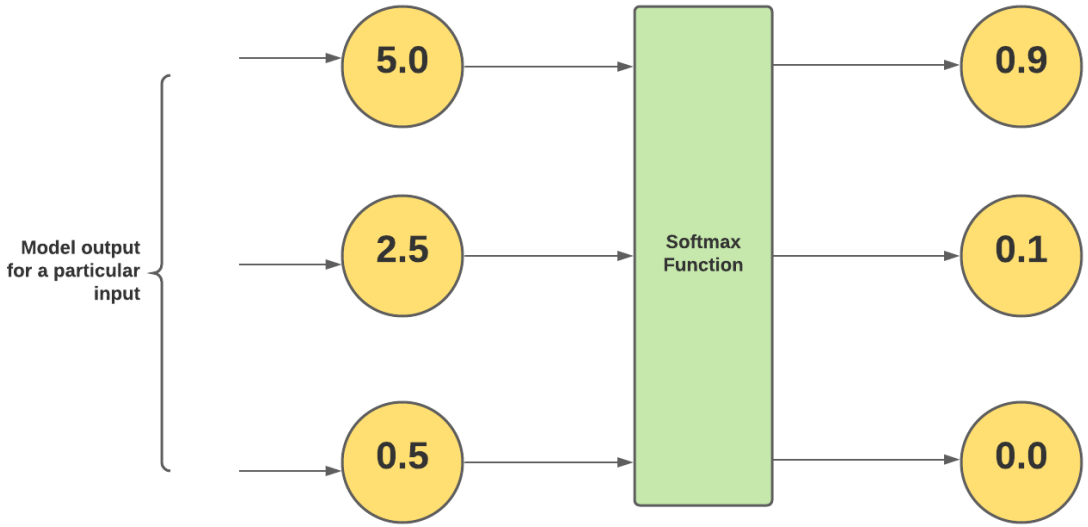
- Vanishing Gradient Problem:
  - ReLU is an activation function that is known as to better transmit error than Sigmoid



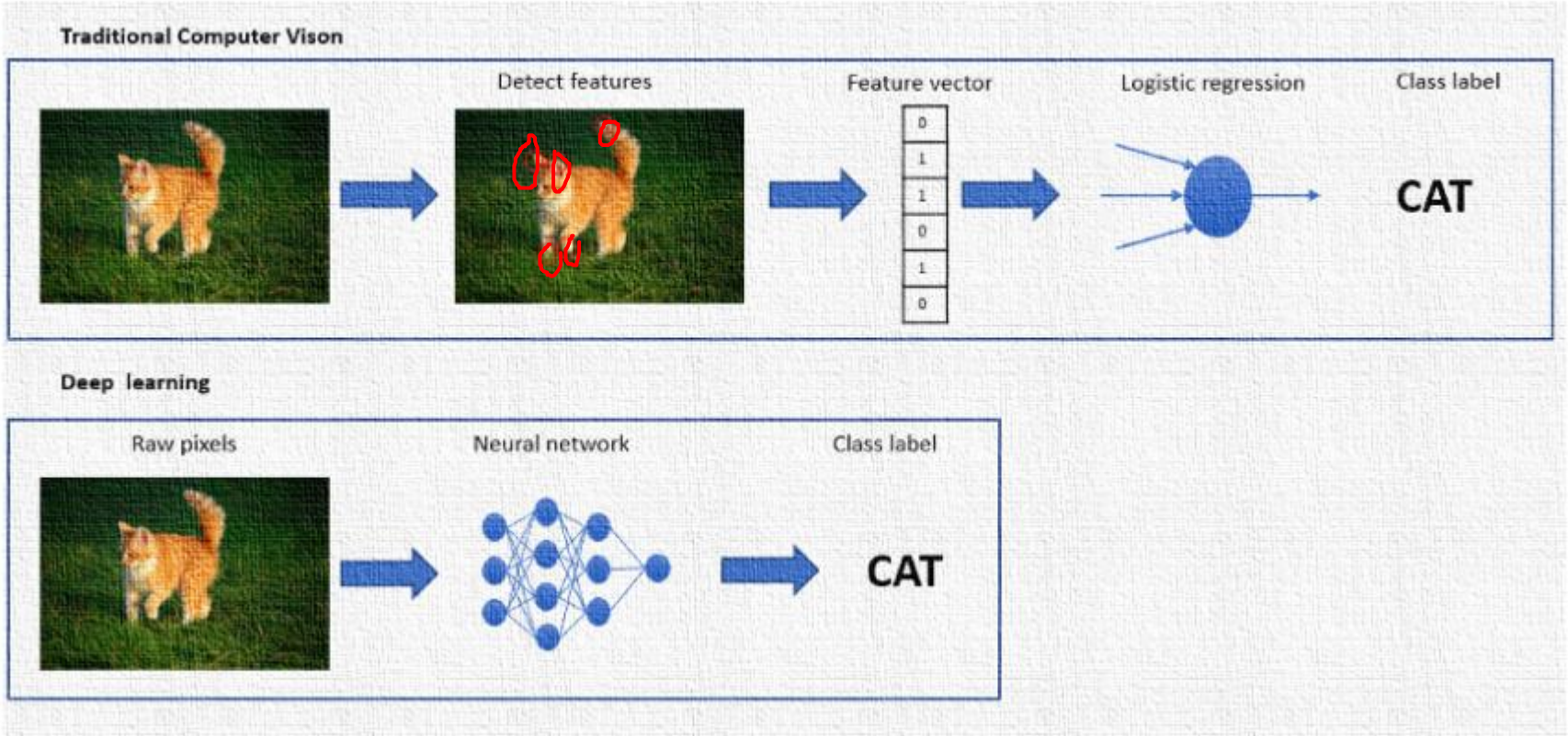
SoftMax

The softmax function is a function that turns a vector of K real values into a vector of K real values that sum to 1. The input values can be positive, negative, zero, or greater than one, but the softmax transforms them into values between 0 and 1, so that they can be interpreted as probabilities.



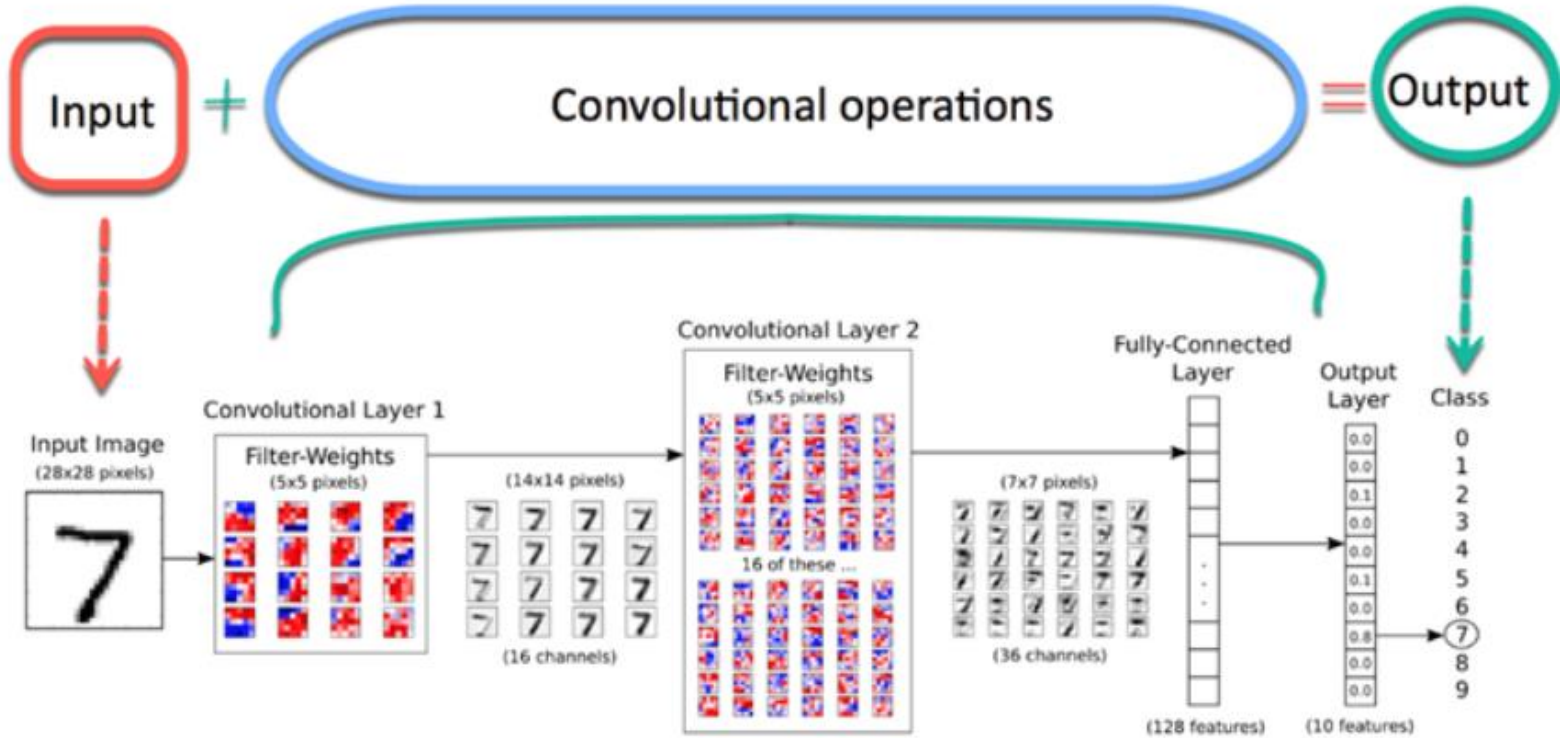


Computer Vision



CNN

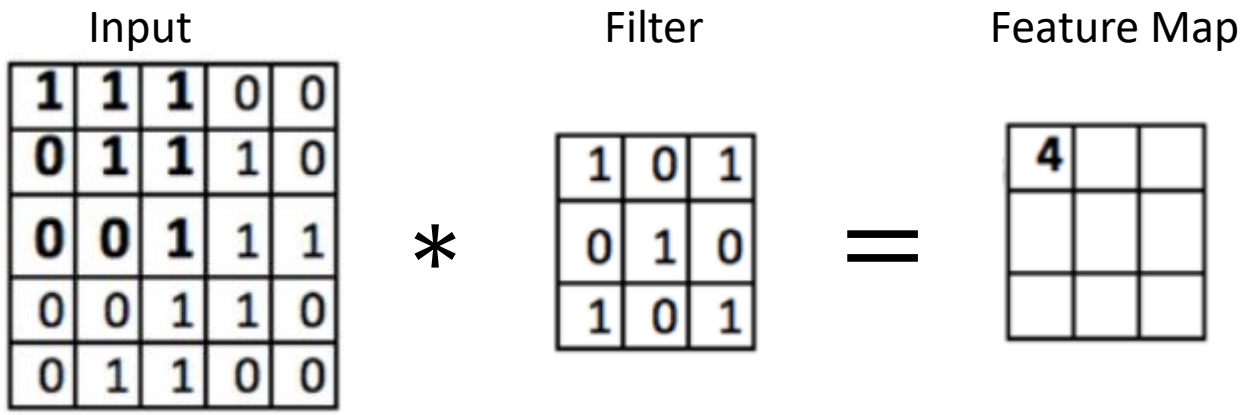
- Convolutional Neural Network(CNN), are multi-layer neural networks that assume input data to be image.

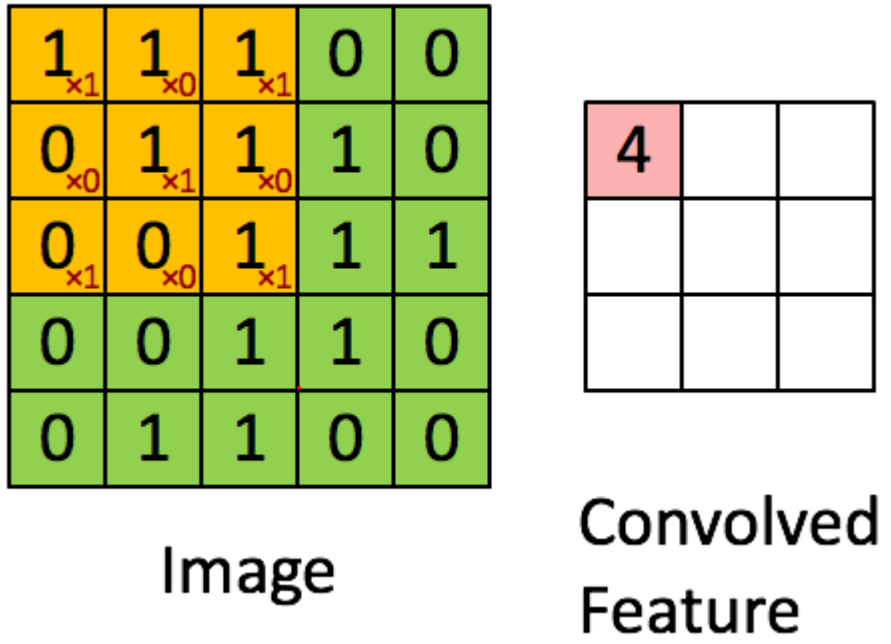


https://www.guru99.com/convnet-tensorflow-image-classification.html

Convolutional Layer

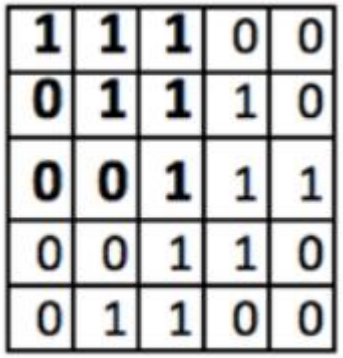
- The purpose of the convolution is to extract the features of the object on the image locally. It means the network will learn specific patterns within the picture and will be able to recognize it everywhere in the picture.
- Image is basically 2D Matrix:



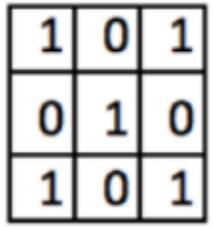


Convolutional Layer: Output

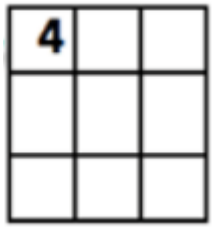
- Out = $\frac{n - f + 2*P}{s} + 1 \quad = 2 + 1 = 3 \ where \ s = 1, p = 0$



nxn



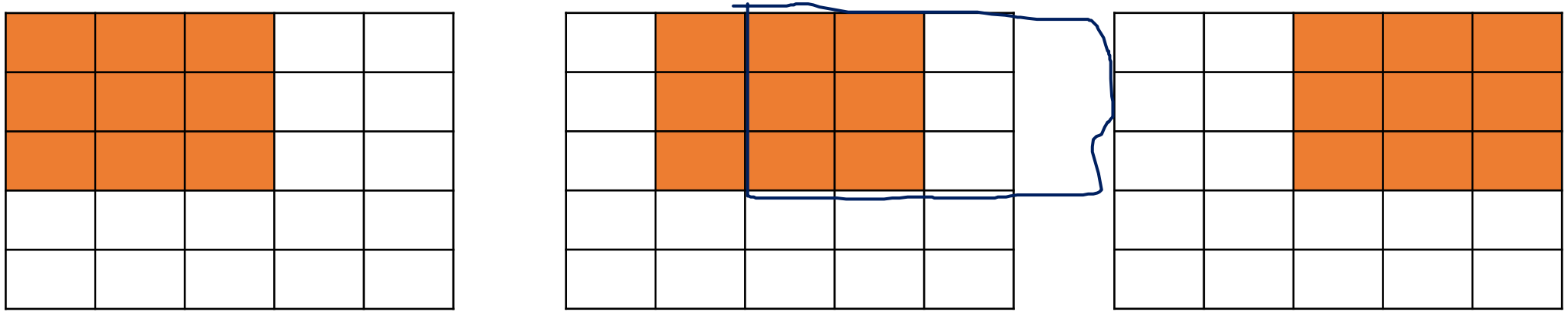
fxf



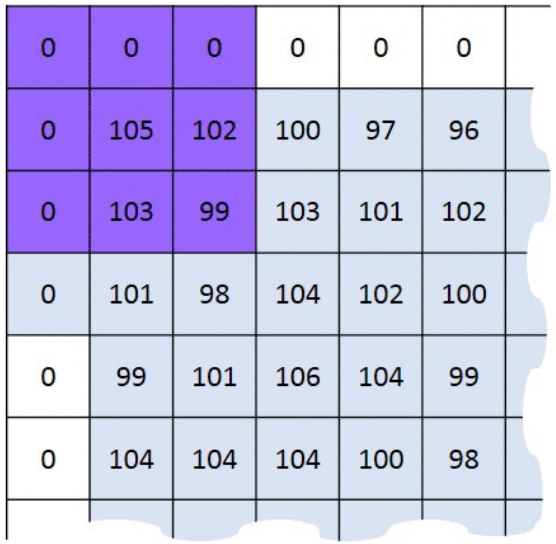
out

Convolutional Layer: Stride (s)

- The filter is moved across the image left to right, top to bottom, with a one-pixel column change on the horizontal movements, then a one-pixel row change on the vertical movements.
- The amount of movement between applications of the filter to the input image is referred to as the stride, and it is almost always symmetrical in height and width dimensions.
- Default stride is 1



Convolutional Layer: Stride (s)



0	0	0	0	0	0
0	105	102	100	97	96
0	103	99	103	101	102
0	101	98	104	102	100
0	99	101	106	104	99
0	104	104	104	100	98

Image Matrix

Kernel Matrix

0	-1	0
-1	5	-1
0	-1	0

$$0*0+0*-1+0*0$$
$$+0*-1+105*5+102*-1$$
$$+0*0+103*-1+99*0 \quad = 320$$

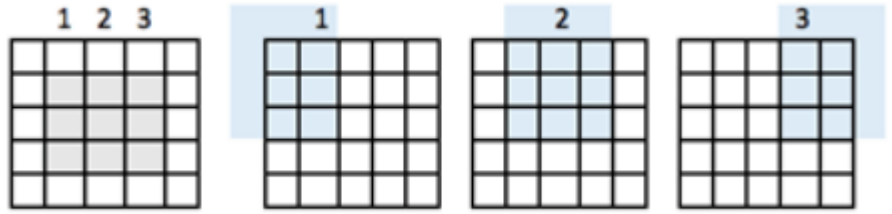
320					

Output Matrix

Convolution with horizontal and vertical strides = 1

Convolutional Layer: Padding (p)

- By default, a filter starts at the left of the image with the left-hand side of the filter sitting on the far left pixels of the image. The filter is then stepped across the image one column at a time until the right-hand side of the filter is sitting on the far right pixels of the image.



Border Effect

- To get the same output dimension as the input dimension, you need to add padding. Padding consists of adding the right number of rows and columns on each side of the matrix. It will allow the convolution to center fit every input tile.

RELU (Non-Linear Activation Function)

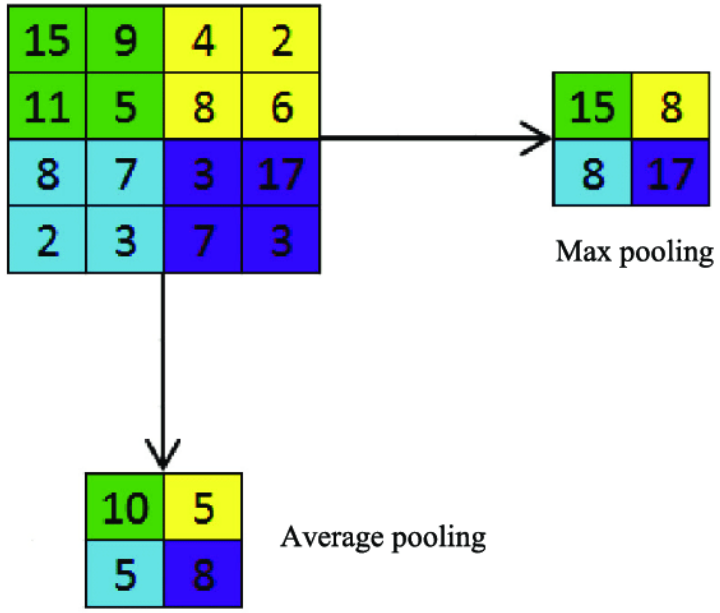
- Non Linearity (ReLU)
- At the end of the convolution operation, the output is subject to an activation function to allow non-linearity. The usual activation function for convnet is the Relu. All the pixel with a negative value will be replaced by zero.

Vanishing Gradient Problem:

ReLU is an activation function that is known as to better transmit error than Sigmoid

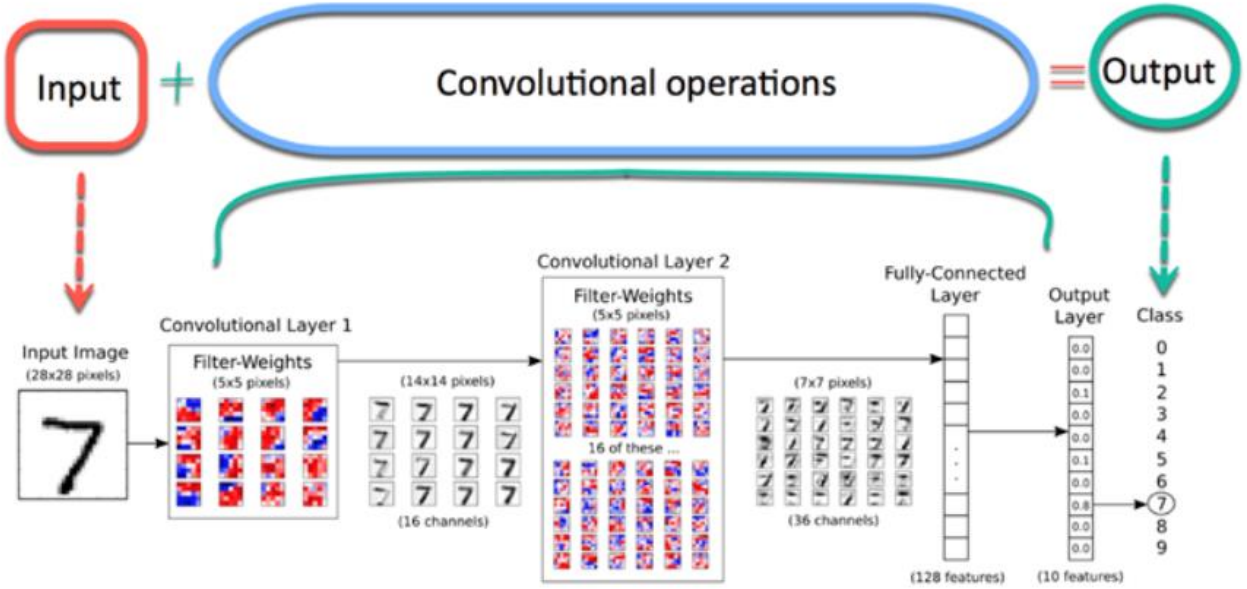
Pooling Layer

- The purpose of the pooling is to reduce the dimensionality of the input image. The steps are done to reduce the computational complexity of the operation. By diminishing the dimensionality, the network has lower weights to compute, so it prevents overfitting.
  - Max Pooling
  - Average Pooling



Fully Connected (Dense) Layers

- The feature map has to be flatten before to be connected with the dense layer.
- Dense Layers are Artificial Neural Network



Other Material

- https://www.deeplearningwizard.com/deep_learning/practical_pytorch/pytorch_convolutional_neuralnetwork/