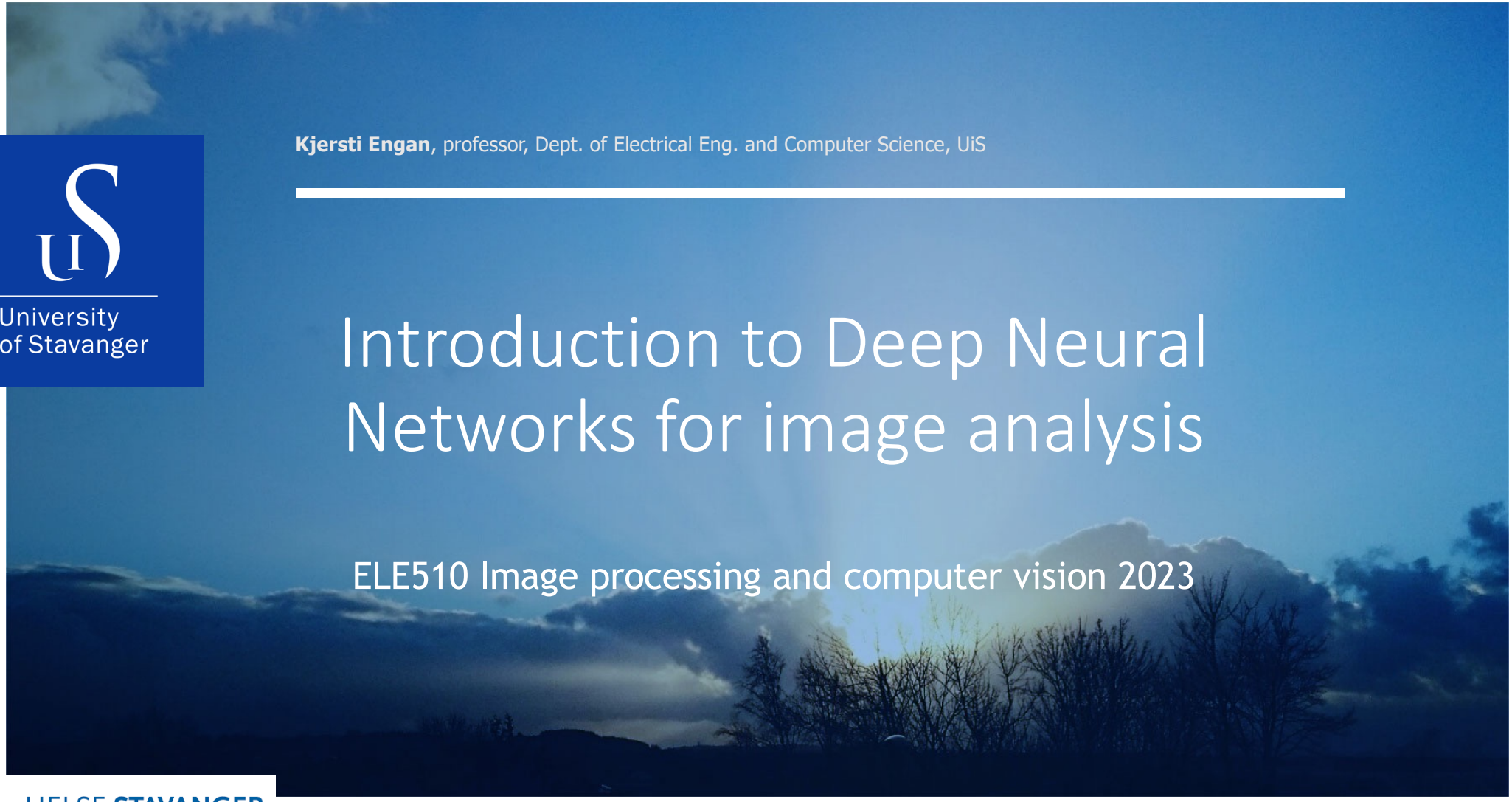


Kjersti Engan, professor, Dept. of Electrical Eng. and Computer Science, UiS

University of Stavanger

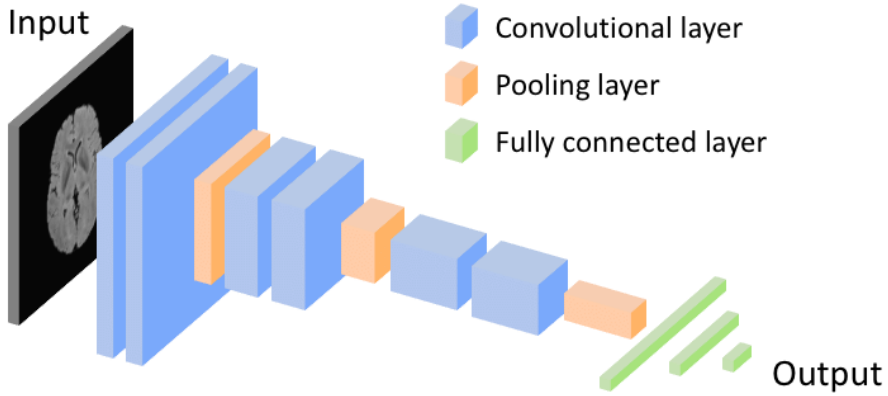
Introduction to Deep Neural Networks for image analysis

ELE510 Image processing and computer vision 2023

HELSE STAVANGER
Stavanger universitetssjukehus

Intro to Deep Neural Network for image analysis

Three points form the topic:



1. What is a artificial neuron?
2. How does convolutional neural network relate to spatial filtering (convolution)
3. What is supervised learning?

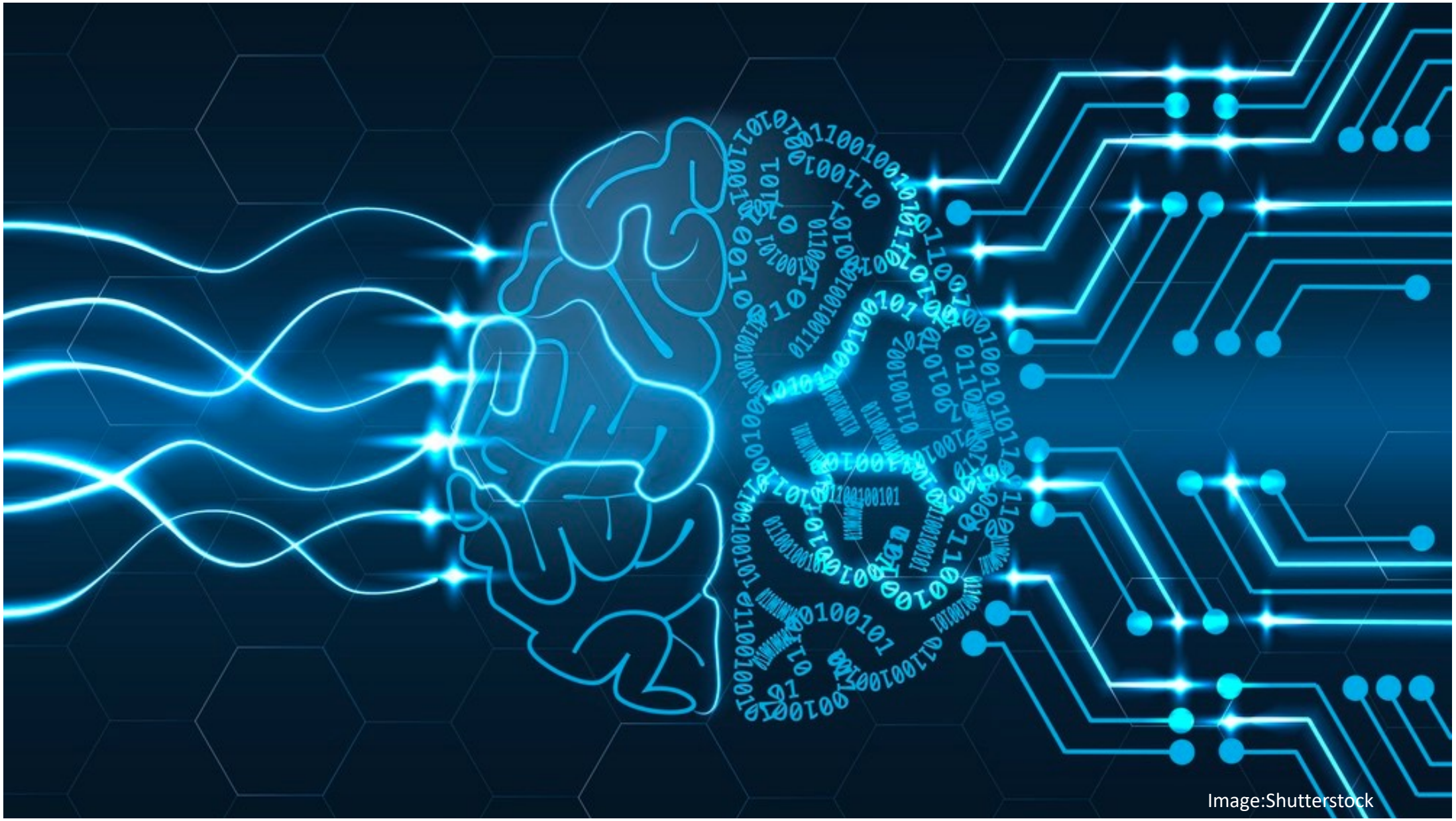
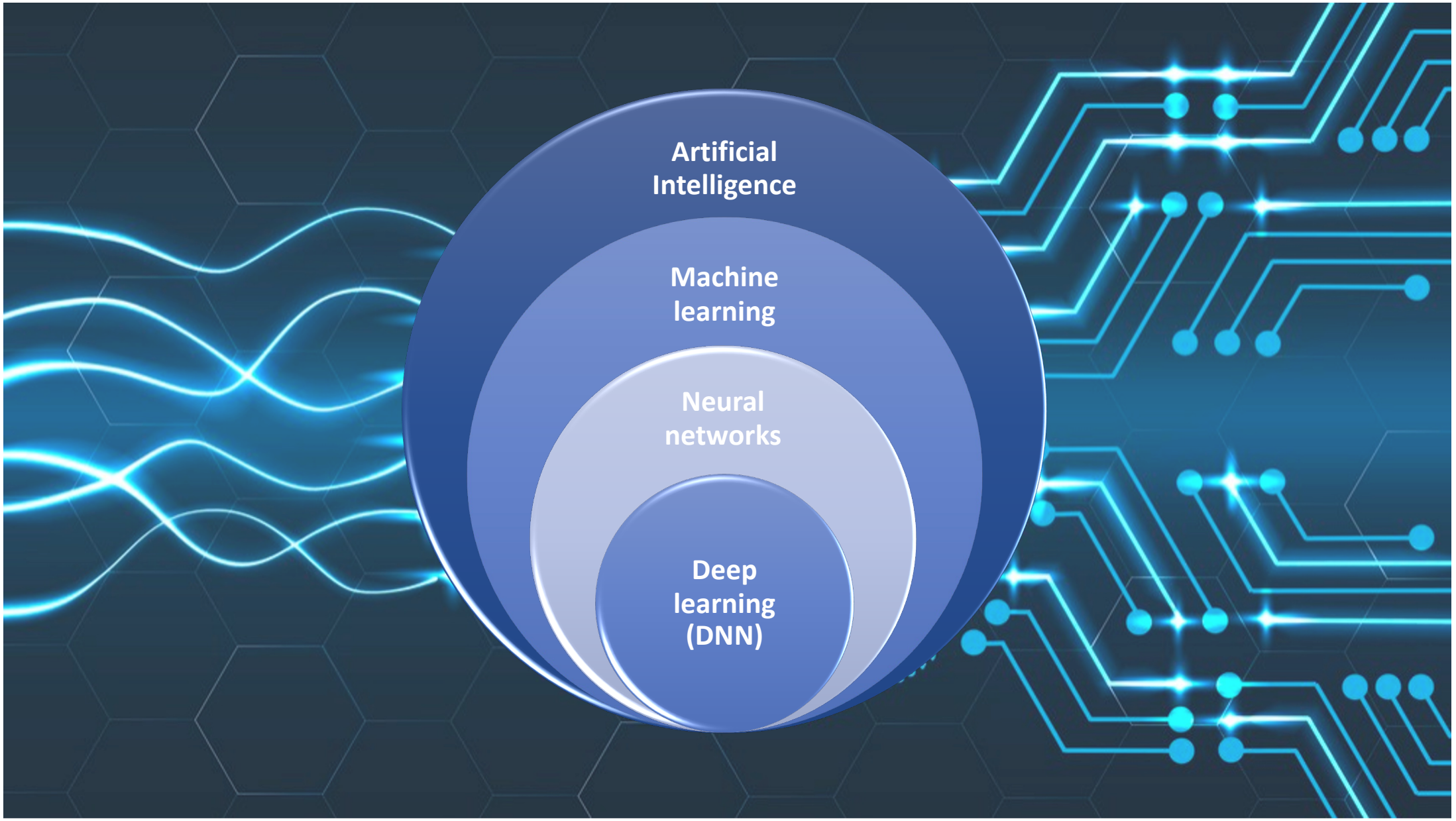


Image:Shutterstock


Artificial Intelligence
Machine learning
Neural networks
Deep learning (DNN)

Neural Networks for images

Generate an image from text - And much more..

Style transfer

"Paint" this image with the style of another image

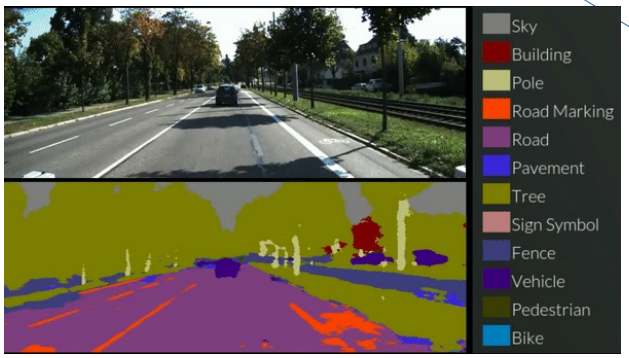
What is in the image?

Classification, easy these days

Object detection, still a lot harder

Where in the image is it?

Segmentation



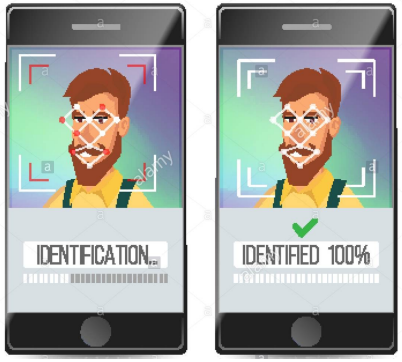
What am I seeing?

Find a specific shape in the image

Landmark detection

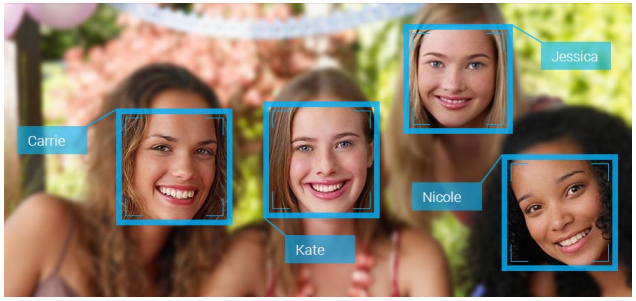
Is this person bob?

Face verification (1:1 matching)



Who is in this image?

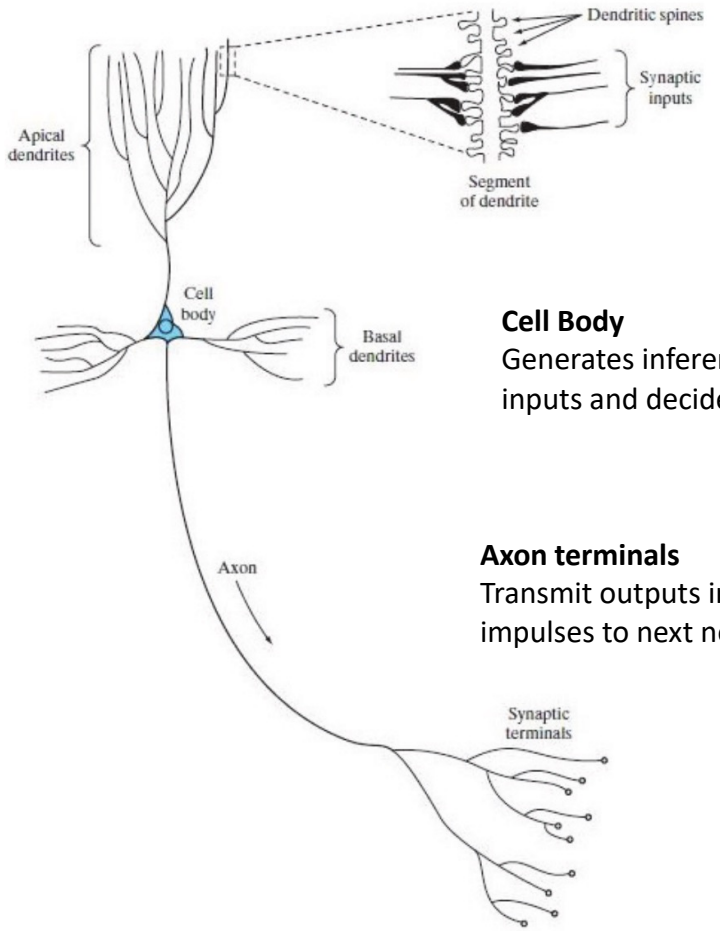
Face recognition (1:N matching)



Is there a face in this image?

Face detection

Biological neurons

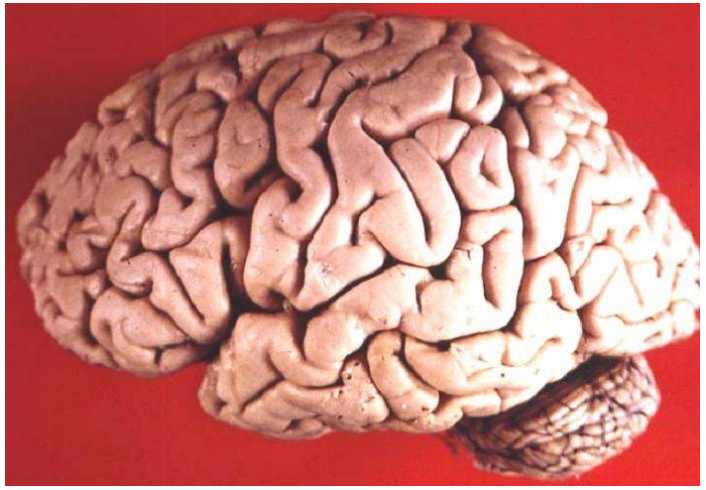


Zayegh, Amer, and Nizar Al Bassam.
"Neural network principles and applications."
Digital Systems. IntechOpen, 2018.

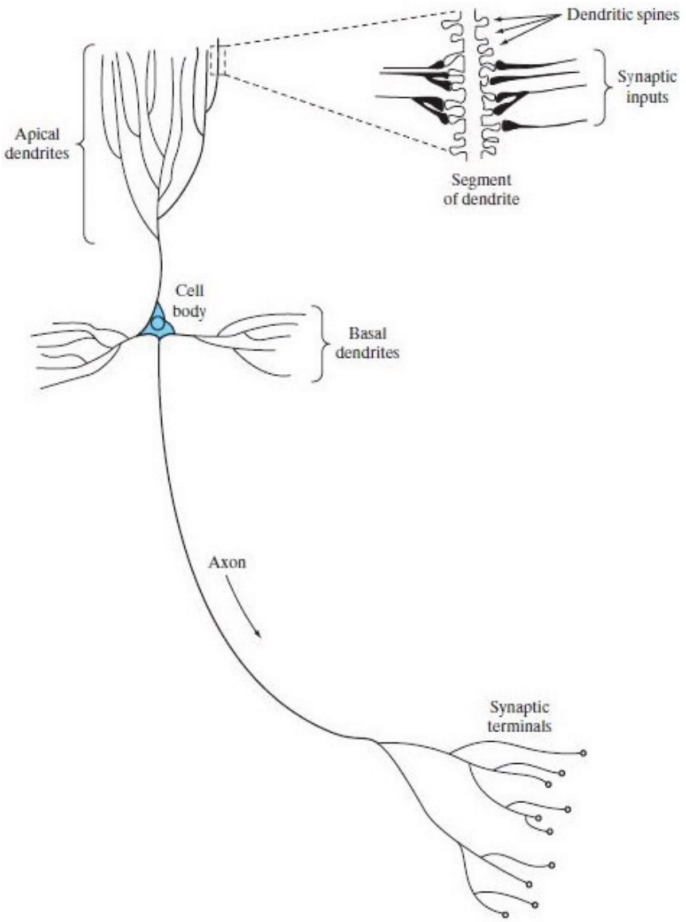
Dendrites
Input from other neurons in the network in form of electrical impulses

Cell Body
Generates inferences from the dendrite inputs and decides what action to take

Axon terminals
Transmit outputs in form of electrical impulses to next neuron

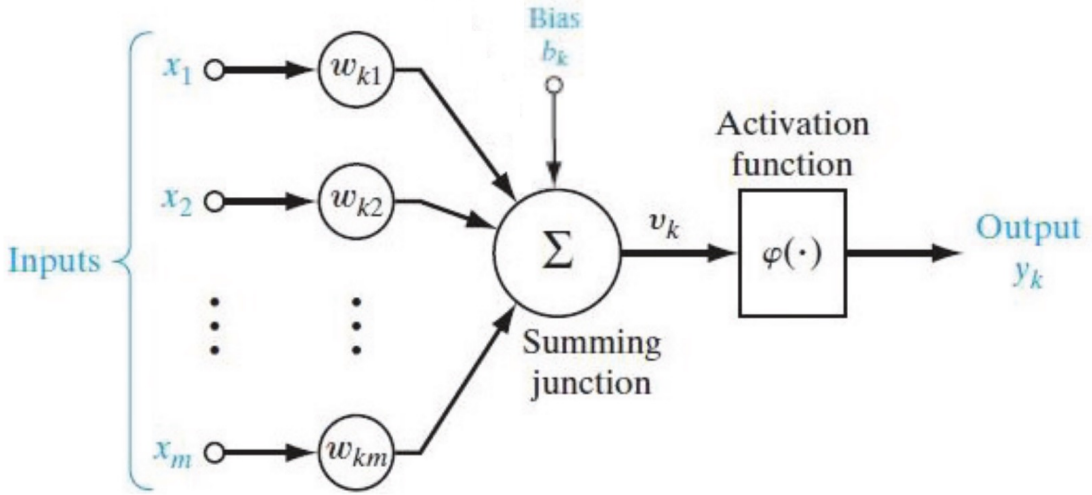


Biological neurons



Zayegh, Amer, and Nizar Al Bassam.
"Neural network principles and applications."
Digital Systems. IntechOpen, 2018.

Artificial neurons
(It is only an equation)



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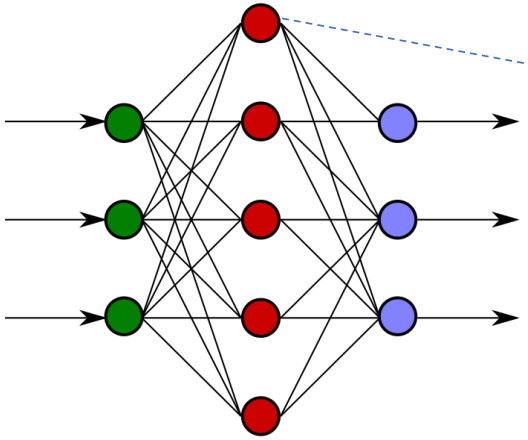
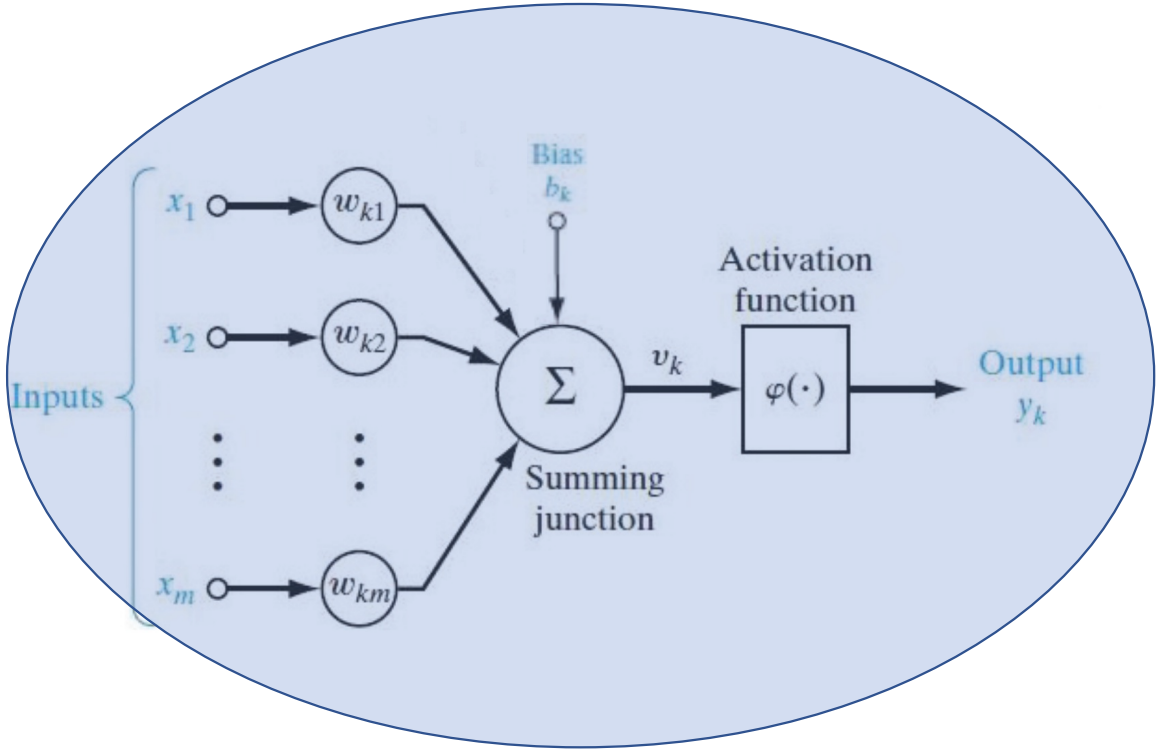
Neural network



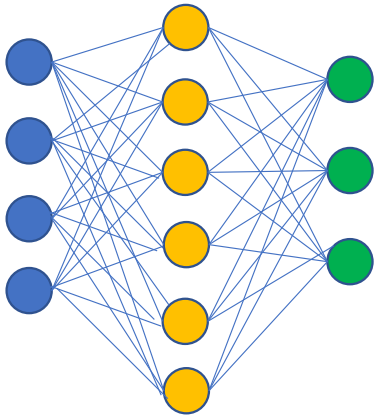


Input layer

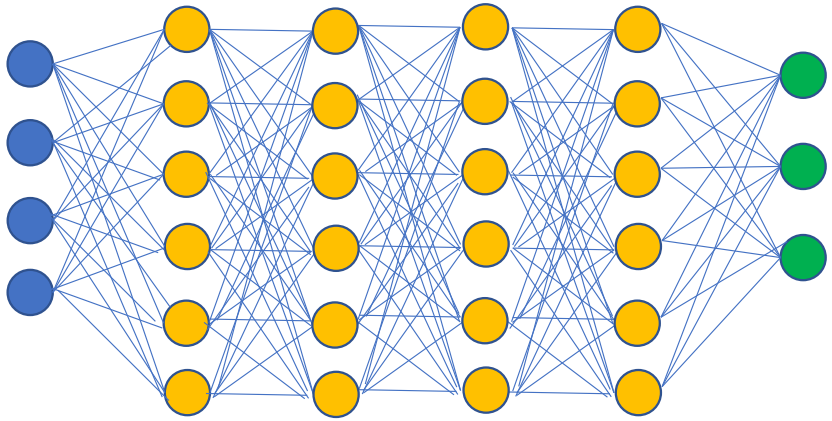
Hidden layer

Output layer

Deep learning / deep neural networks



Simple neural network



Deep neural network

Feed-forward network

Fully connected layers (FC)

Input layer neuron

Hidden layer neuron

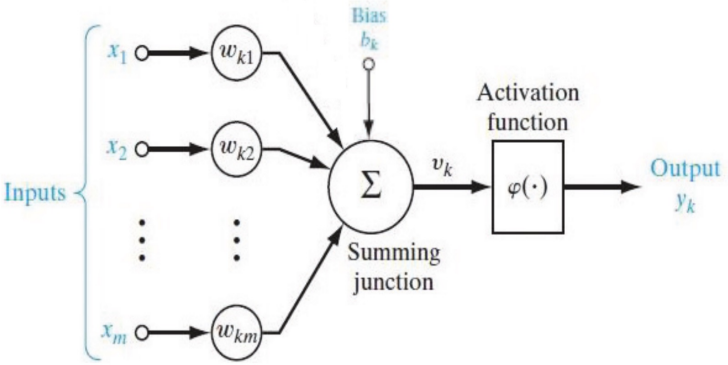
Output layer neuron

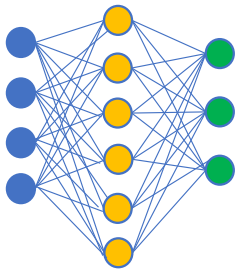
Neurons can have different activation funcitons

- Each connenction have a weight
- Each neuron have a bias

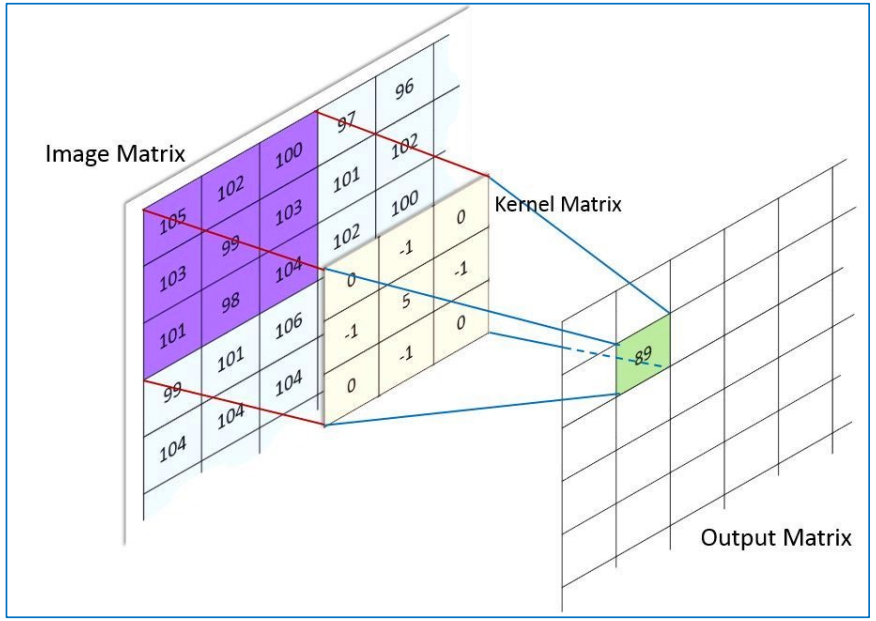
A deep neural network can have millions of parameters
These are learned using example data

Convolutional layers

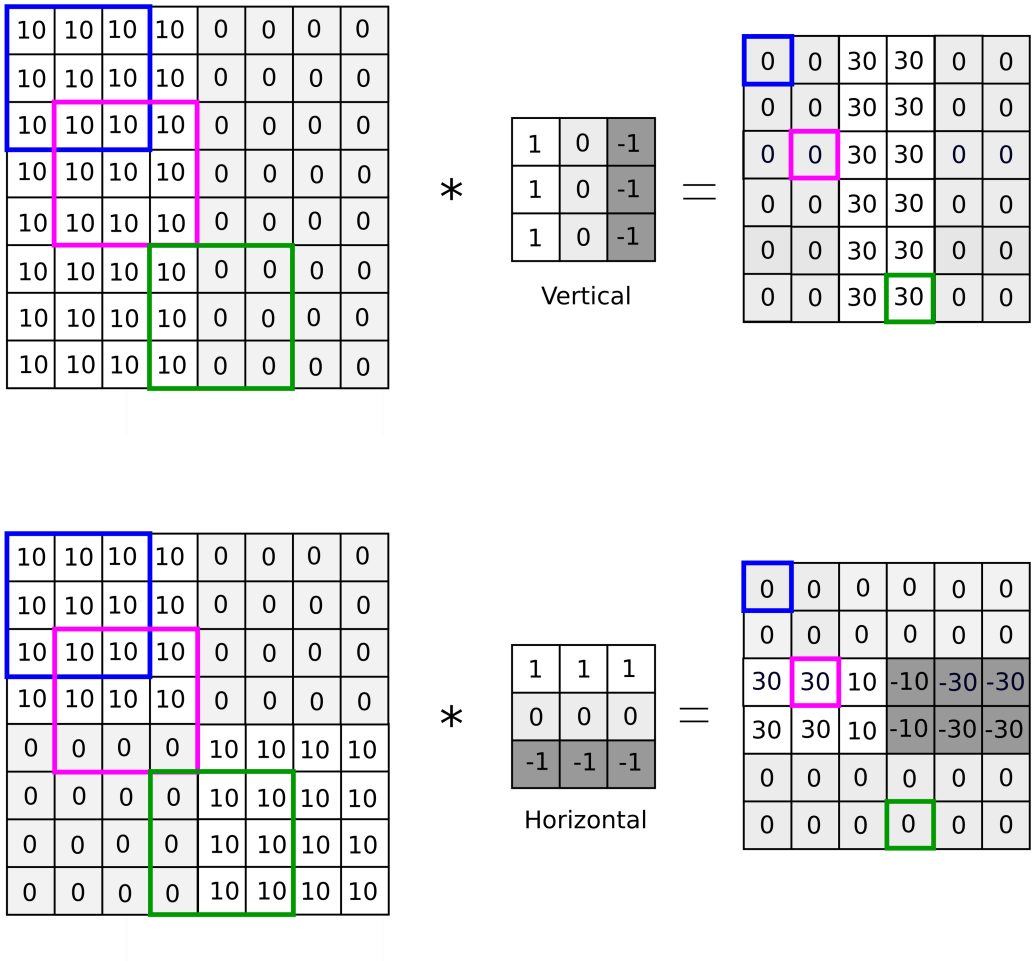




Fully connected layer



Convolution



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

Sobel filter

3	0	-3
10	0	-10
3	0	-3

Scharr filter

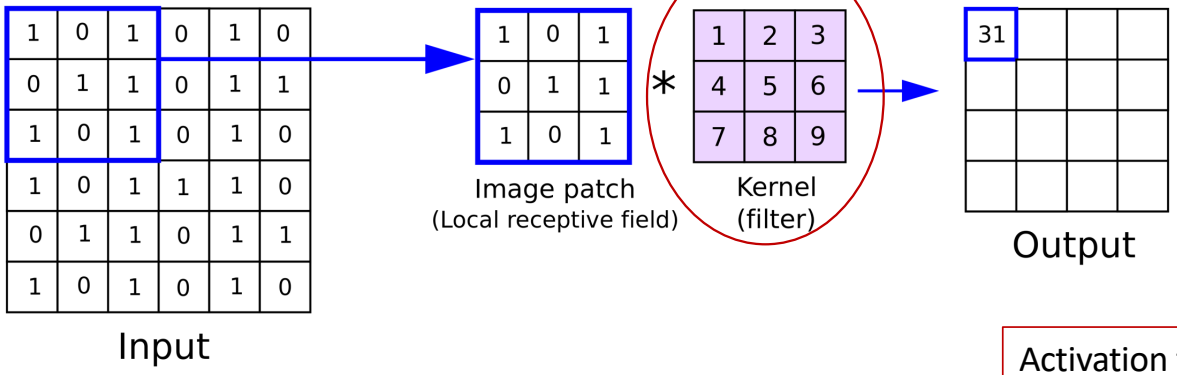
w_1	w_2	w_3
w_4	w_5	w_6
w_7	w_8	w_9

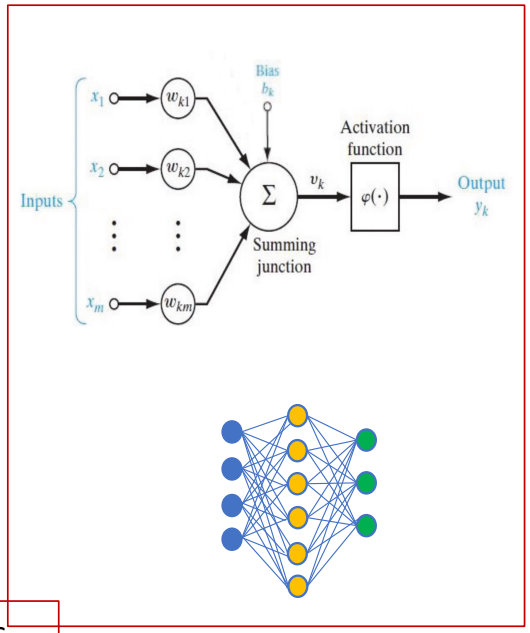
parameterized filter

https://anhreynolds.com/blogs/cnn.html

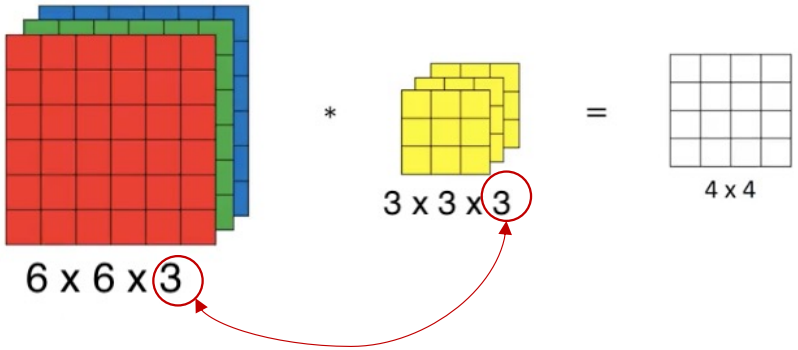
Convolution

Learnable parameters..



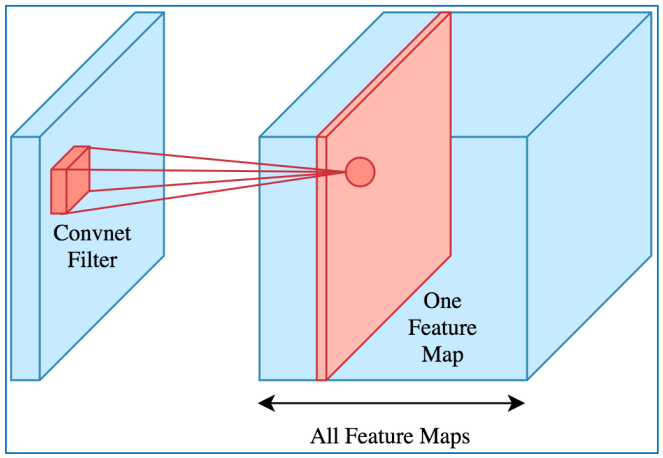


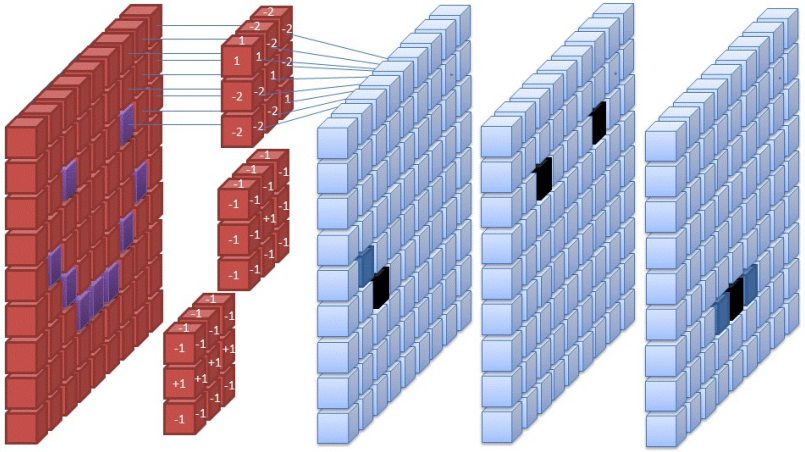
Activation function comes here (for each “pixel”)

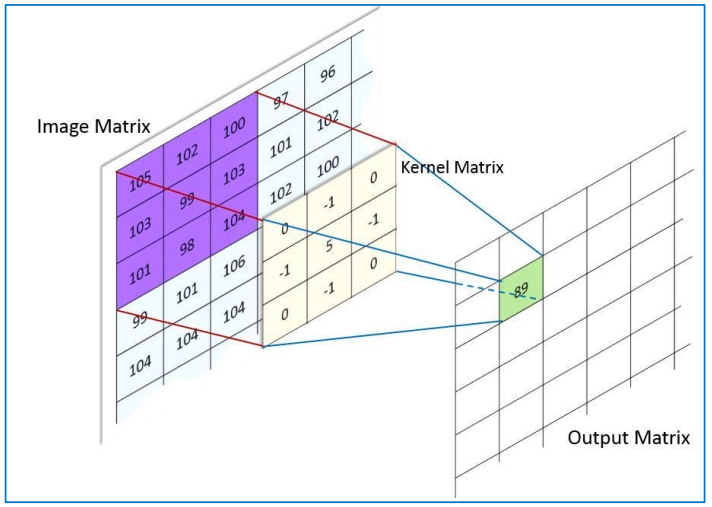


Stride s = 1,
padding p=0, (why is output smaller?)
1 filter

Convolutional layers







Many convolutional filters are used, give a range of feature maps. The filter coefficients are LEARNED (machine learning).

https://commons.wikimedia.org/wiki/File:3_filters_in_a_Convolutional_Neural_Network.gif

https://brilliant.org/wiki/convolutional-neural-network/