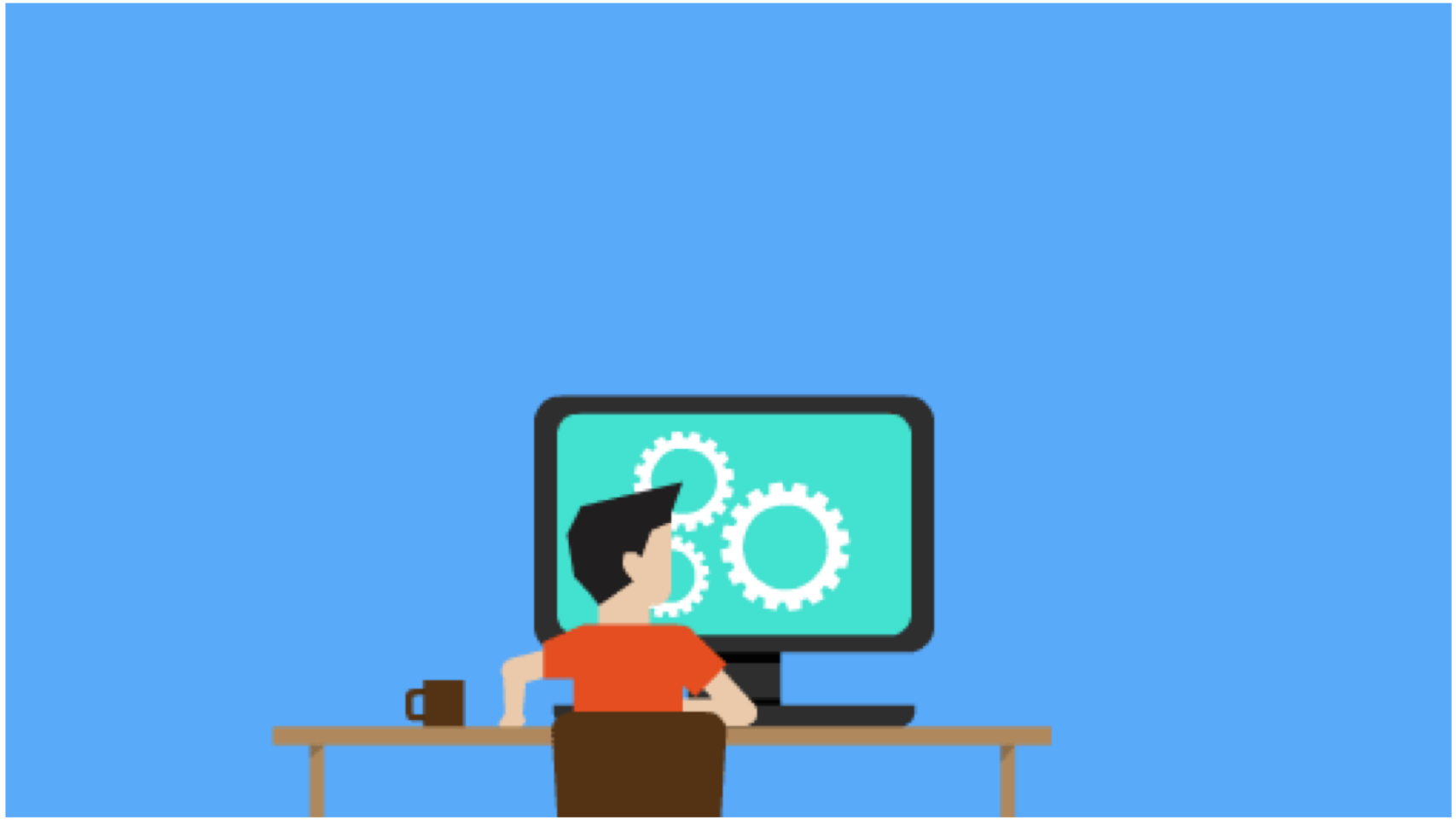
Machine learning and its application in bio-photonics



Roopam K. Gupta

How is machine learning helpful?

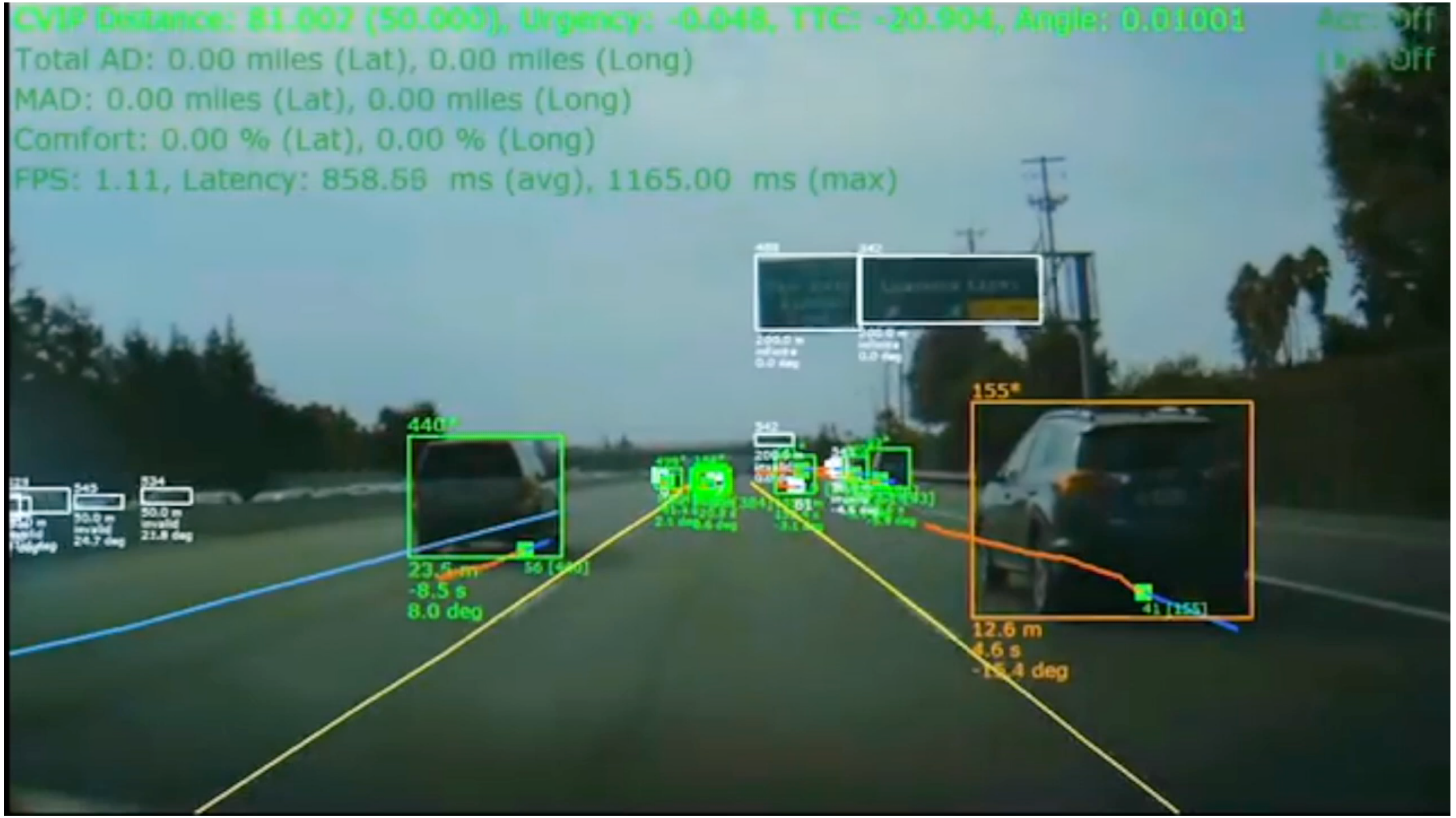
Near human performance of Convolutional neural networks for classification

O. Russakovsky et. Al. "Imagenet large scale visual recognition challenge" Int. J. Comput. Vis. 115,211-252 (2015).

Google translate overlaying English translation for a pack of milk

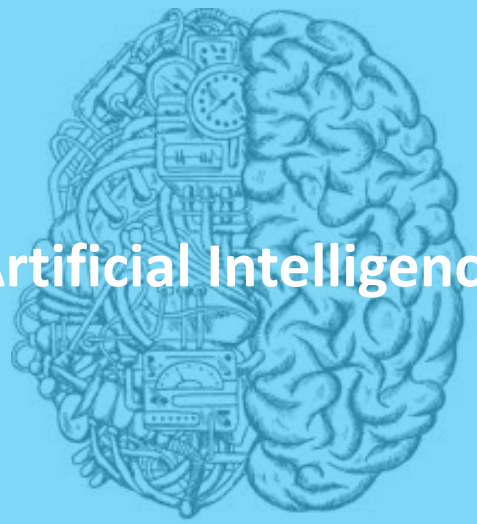
Google tap to translate

Self driving cars!



Reference: https://www.youtube.com/watch?v=0rc4RqYLtEU&t=61s

Artificial Intelligence timeline

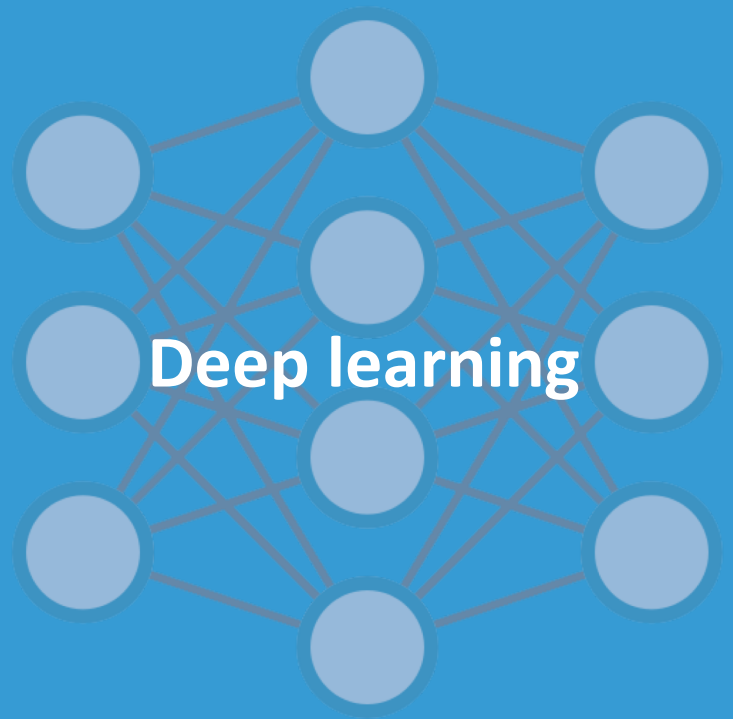


Artificial Intelligence

Idea conceived in 1950s

ML

Machines could classify without human intervention

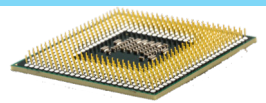


Deep learning

Machines performed tasks with near human precision

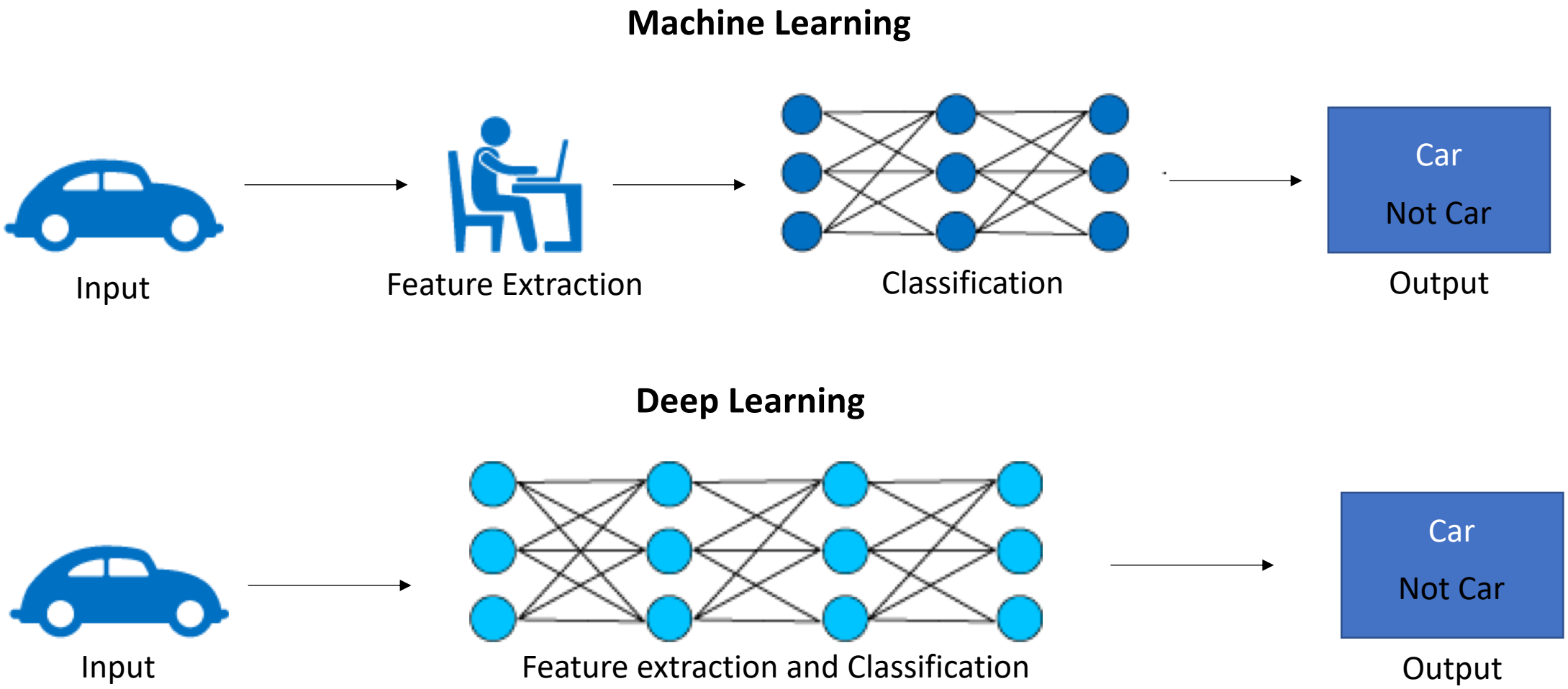
1950s

1980s

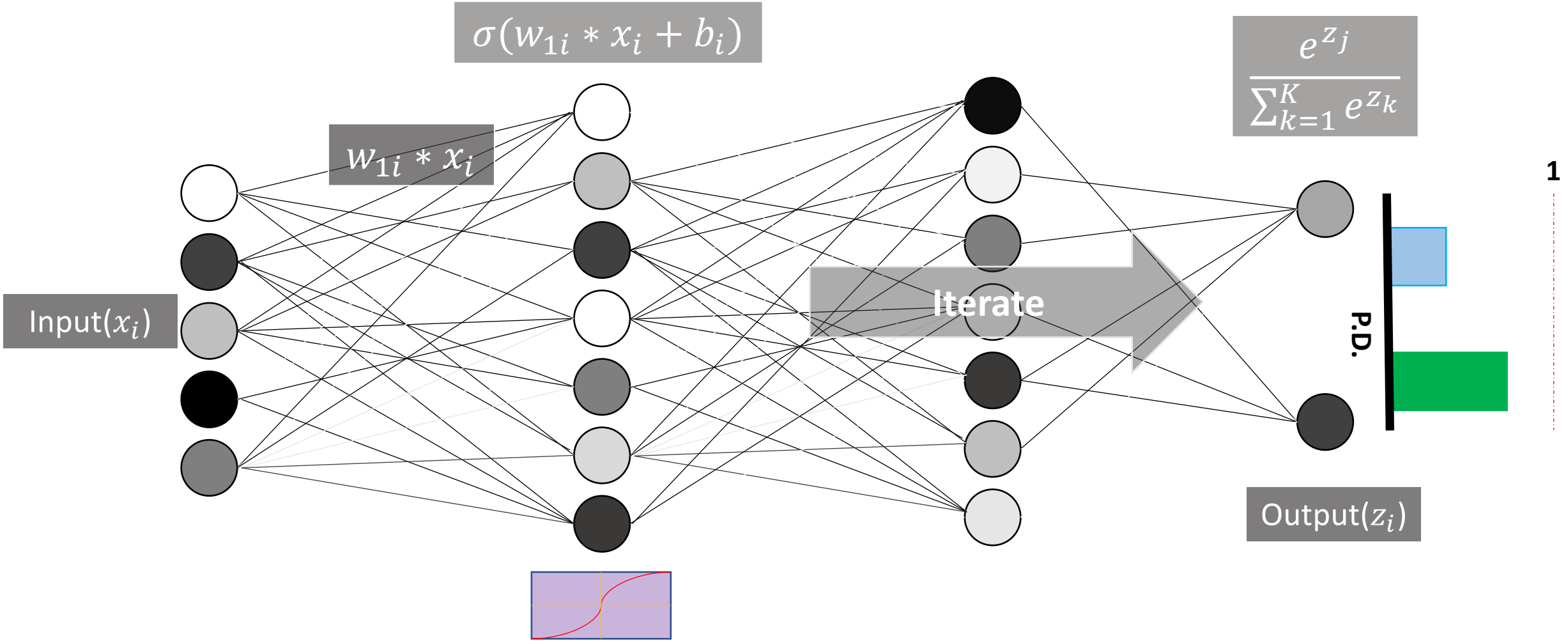


2010s

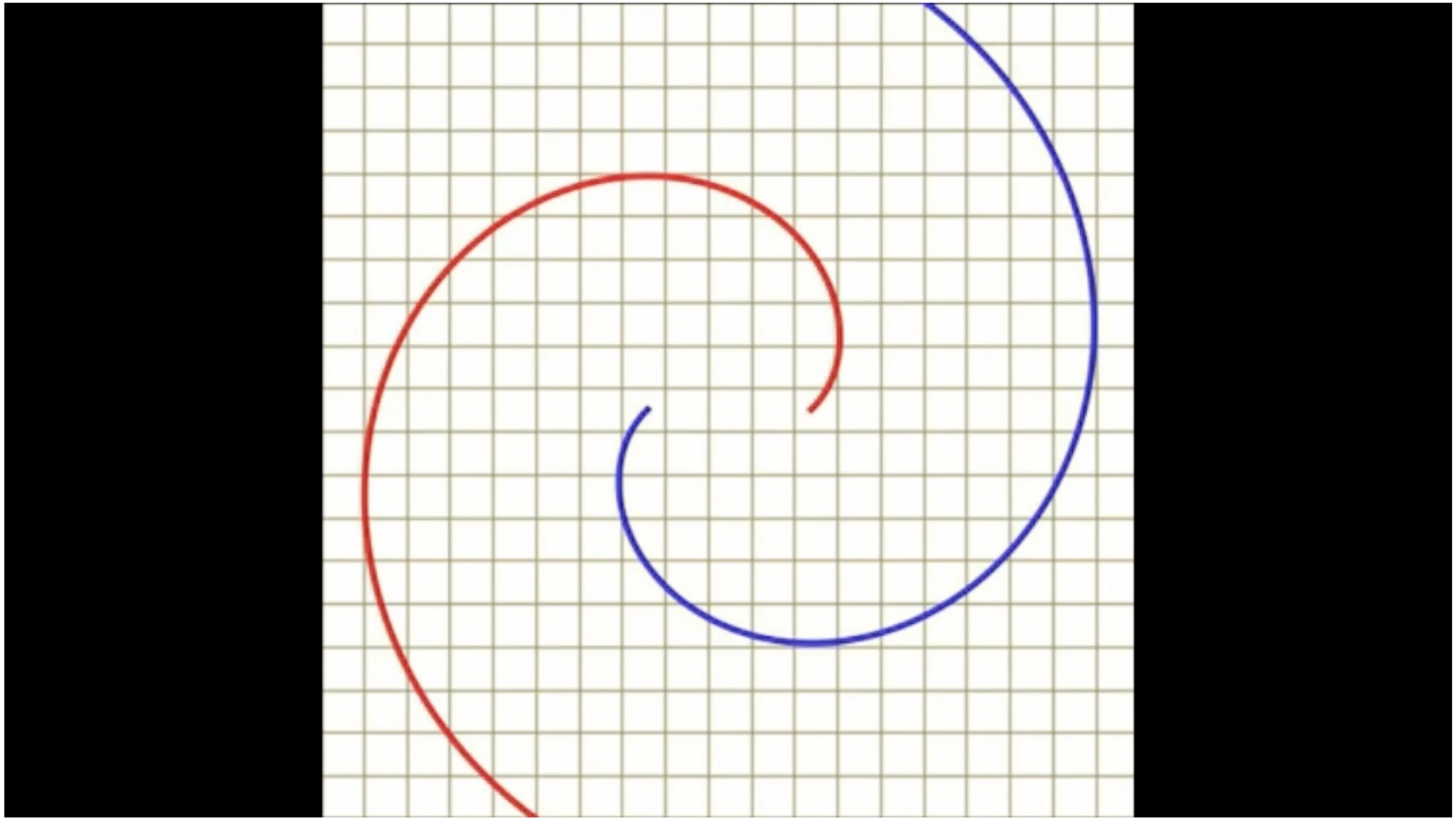
Machine learning to Deep learning



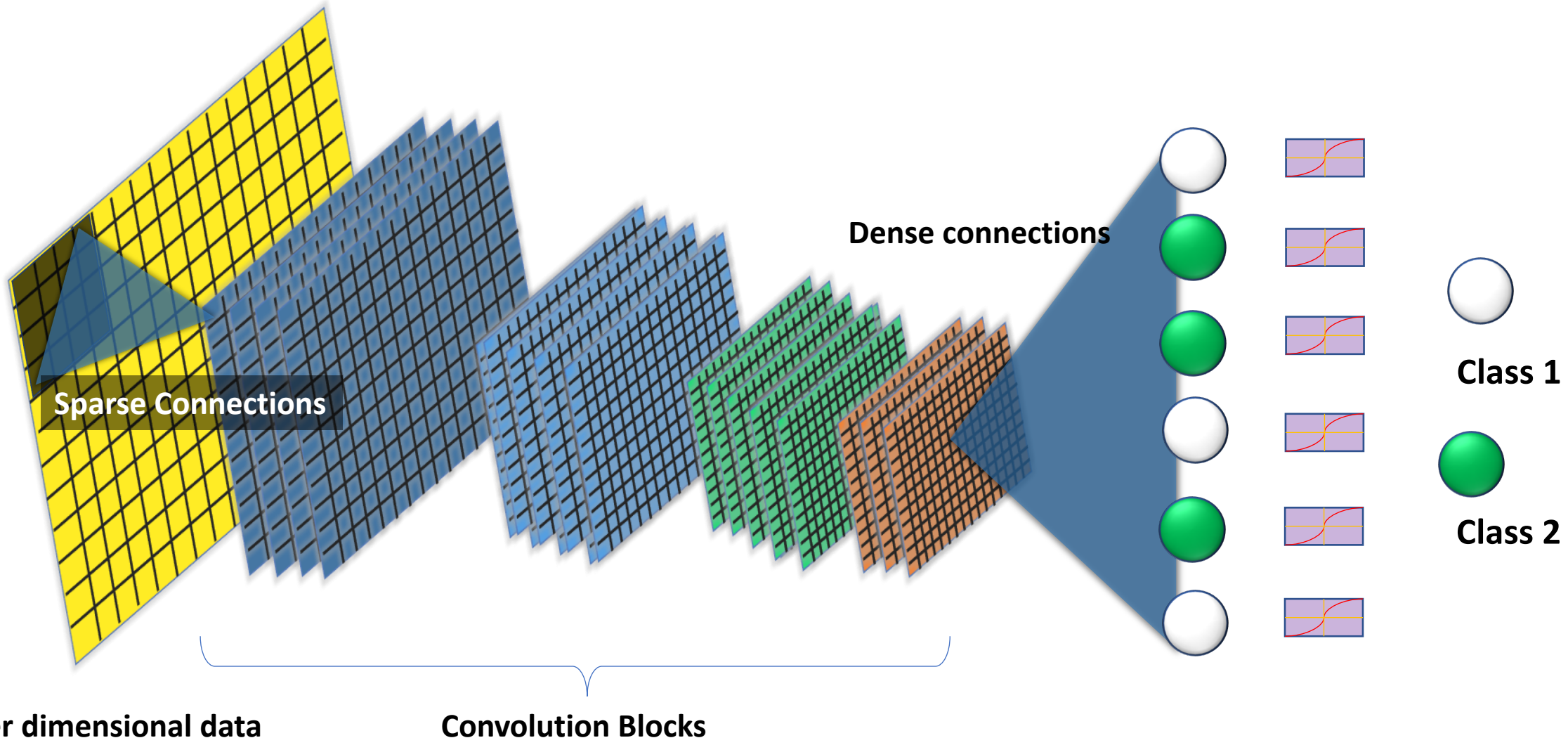
What's a neural network and how does it work?



Simply put

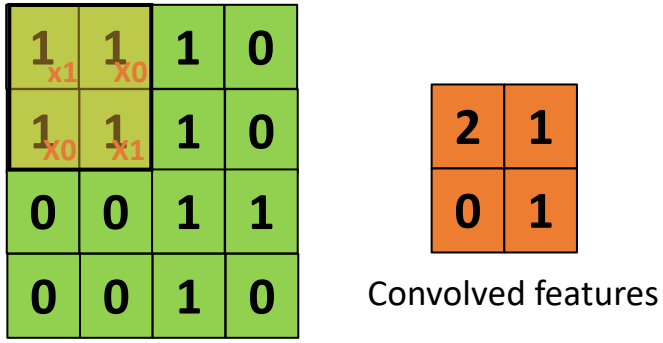


Convolutional neural networks for classification of N-dimensional data



What does a convolution block contains?

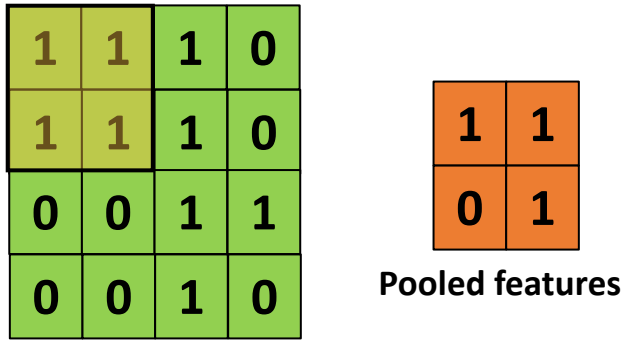
Convolutional layer



Convolved features

Parameterized Filter

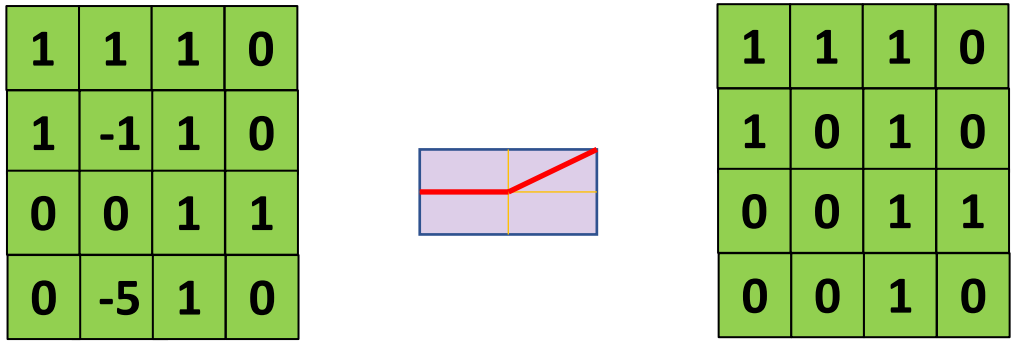
Pooling Layer



Pooled features

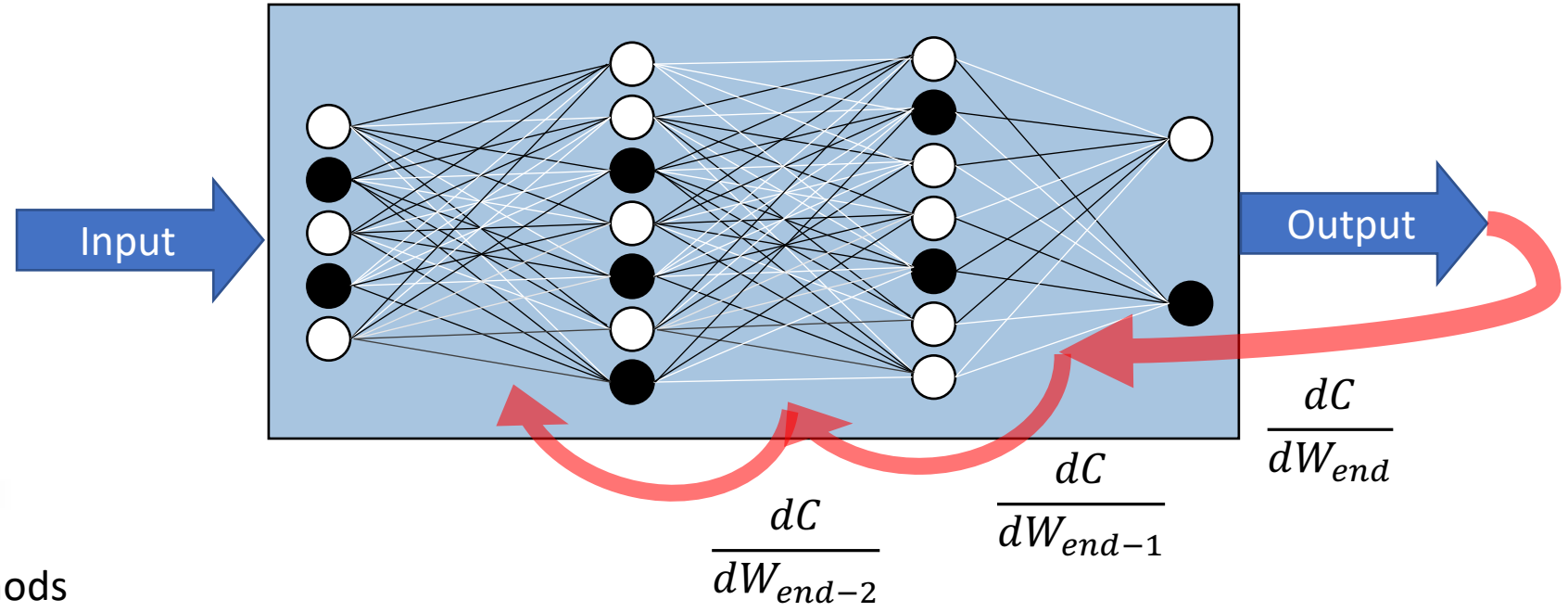
Max Pooling Filter

Non linearity Layer

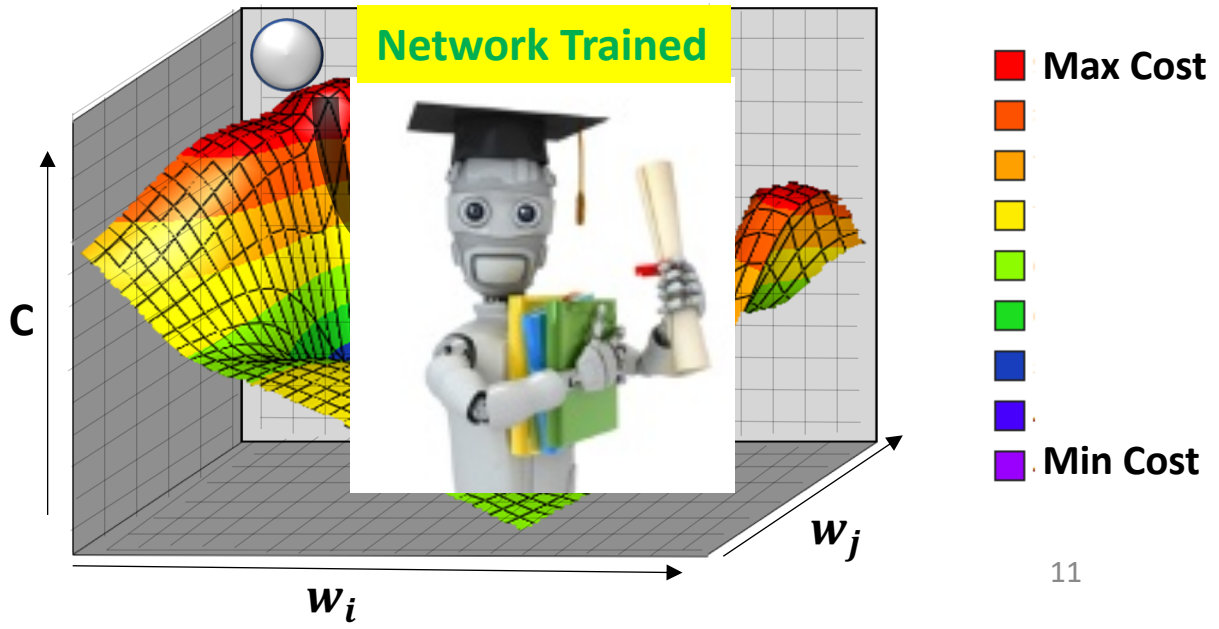


Training a neural network

Inspired by the animal learning methods



Train the network by minimizing:

$$\boldsymbol{Cost} = \begin{cases} -\log(\boldsymbol{output}) & \boldsymbol{if\ target} = 1 \\ -\log(1 - \boldsymbol{output}) & \boldsymbol{if\ target} = 0 \end{cases}$$

Backpropagate the error $\frac{dC}{dW_i}$ to update the parameters using stochastic gradient descent