Introduction to Deep Learning

VIP Machine Learning Course

Deep learning

- Subset of artificial intelligence, and a subset of machine learning.
- A family of machine learning algorithms based on artificial neural networks (ANN) or Artificial Neural Networks.
- Learning methods can be Supervised, Semi-Supervised, or Unsupervised.

Types of neural networks

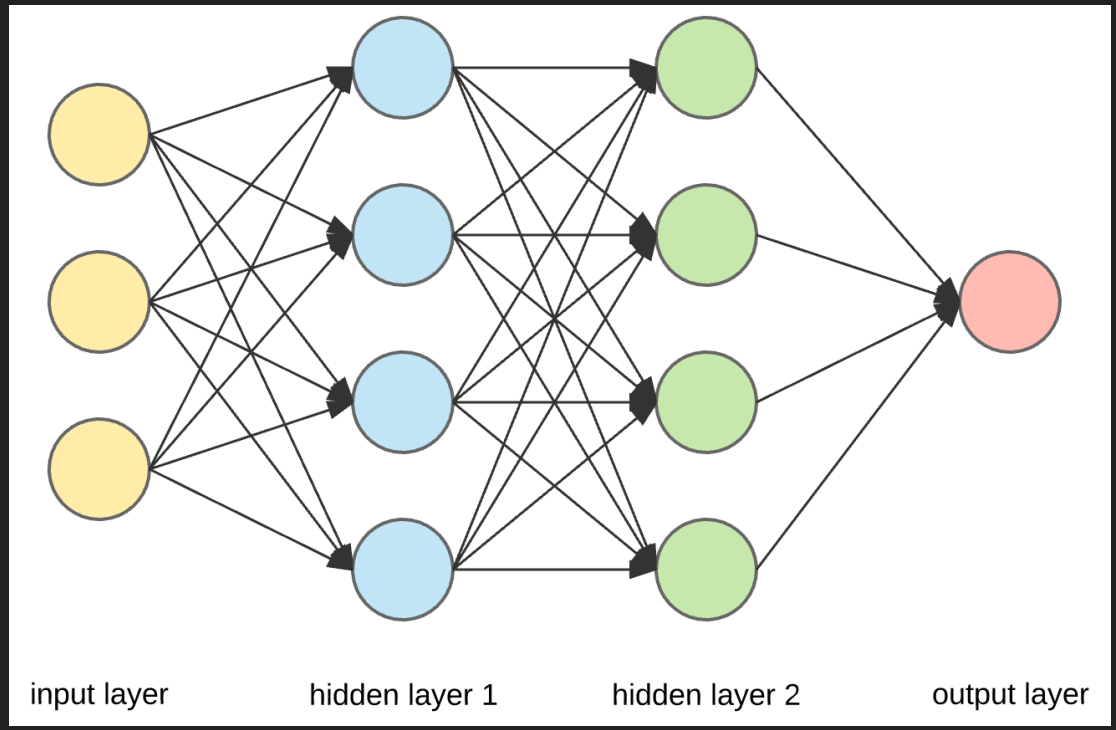
- Multi-Layer Perceptron (MLP) neural network: Used for Classification and Regression problems in Supervised learning where data is structured in tabular form.
  - Some use cases: Image data, textual data, time series.
- Recurrent Neural Network (RNN): Used for sequential data where data points are dependent on previous ones.
  - Some use cases: Time series, Natural Language Processing (NLP), Speech recognition.
- Convolutional Neural Network (CNN): Specifically designed for tasks involving images such as object detection, image classification, and related tasks.
  - Some use cases: Image data, Classification and Regression tasks in image processing.

Artificial Neural Network

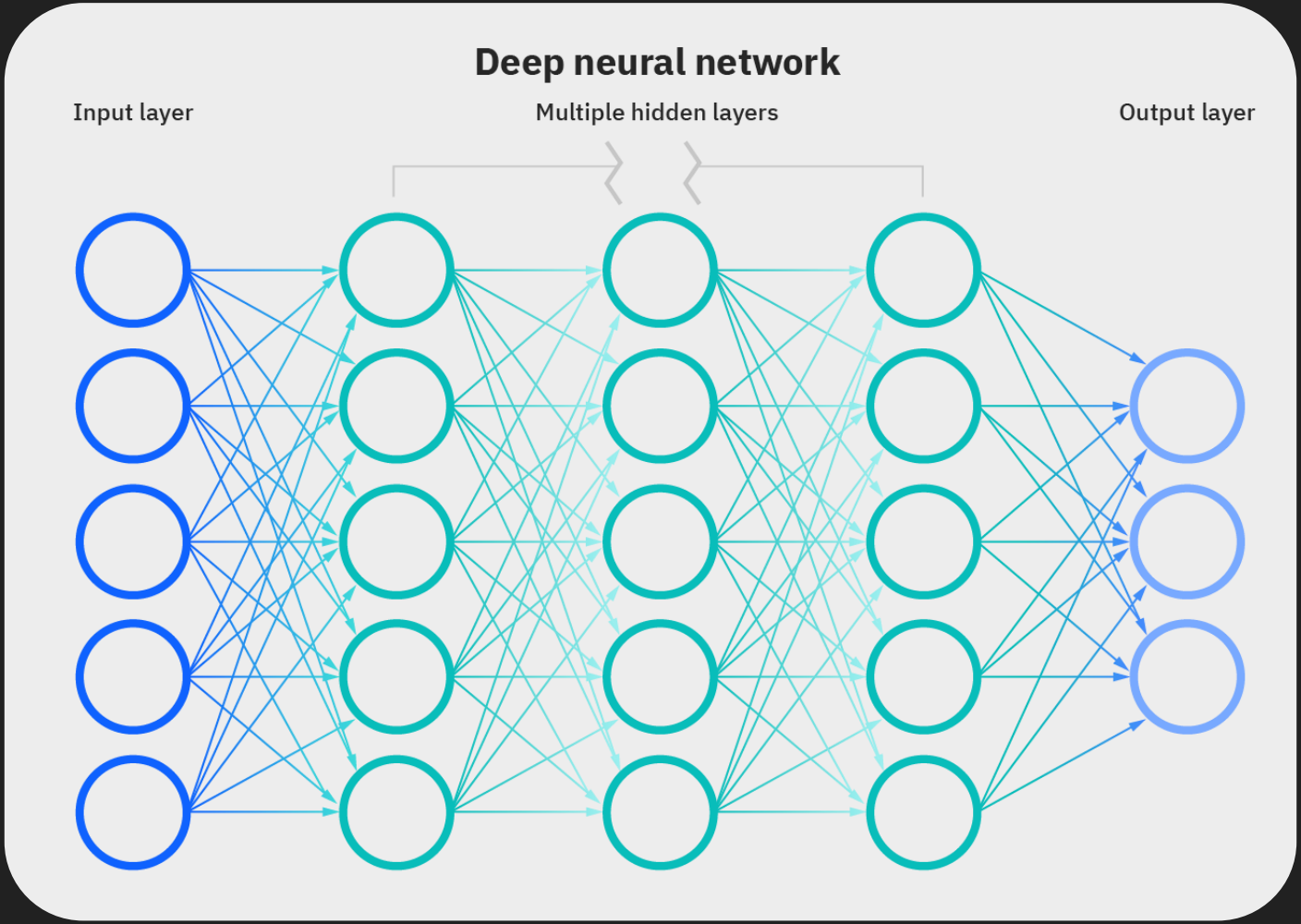
- Sometimes Neural Networks or NNs for short.
- Inspired by the structure of biological neurons.
- A neural network consists of an input layer, an output layer, and several hidden layers.
- Each of these layers contains neurons that are used to train the data.
- The simplest type of neural network is MLP, which is sometimes also known as ANN.

Artificial Neural Network

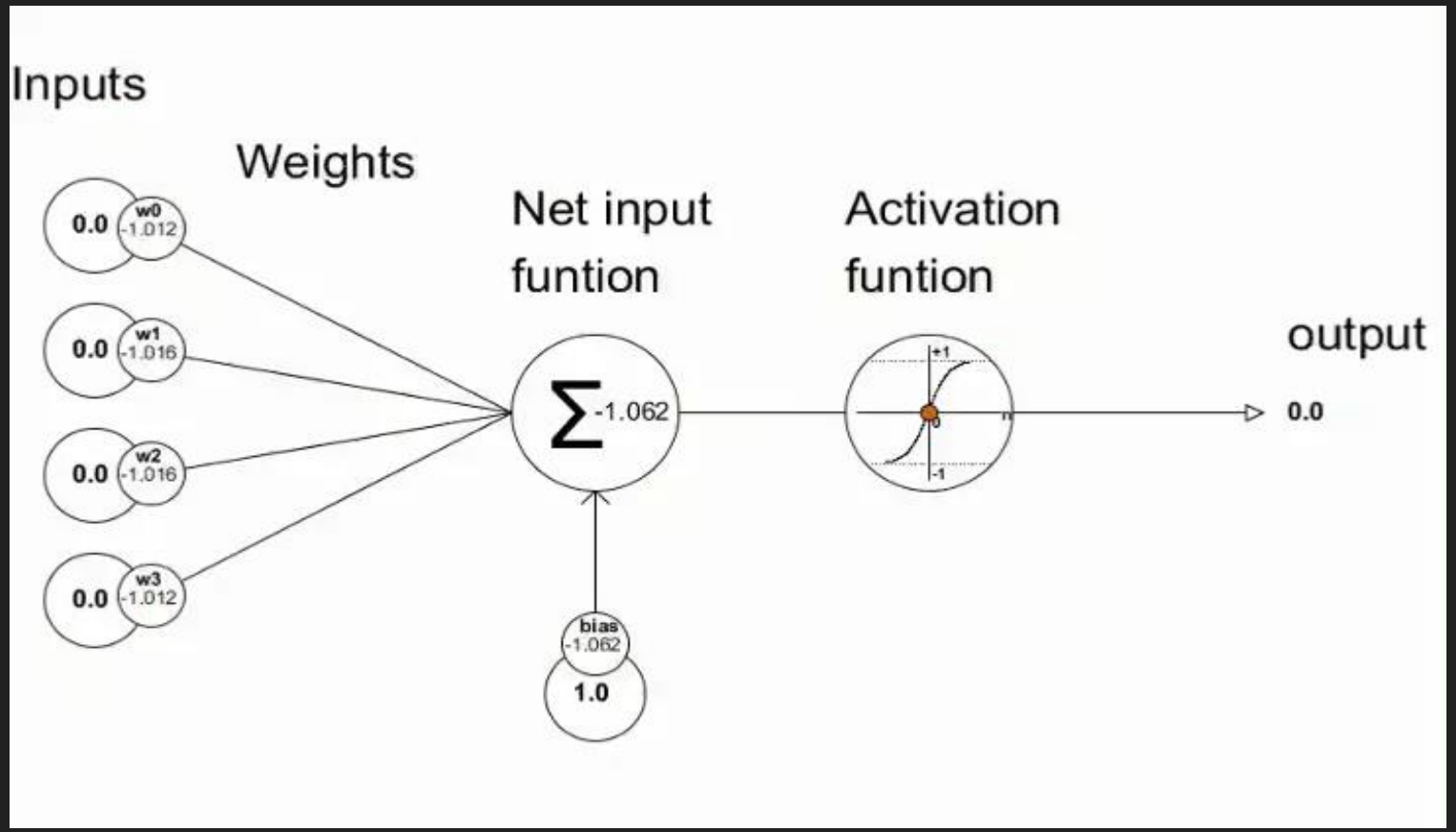
- The number of neurons in the input layer corresponds to the number of input features or independent variables in the problem.
- The number of neurons in the output layer corresponds to the number of output features or dependent variables in the problem.
- The number of hidden layers and the number of neurons in each hidden layer are typically determined through trial and error or previous experience, as there is no specific rule for setting these values.
- Weights, biases, and activation functions are crucial components of neural networks.



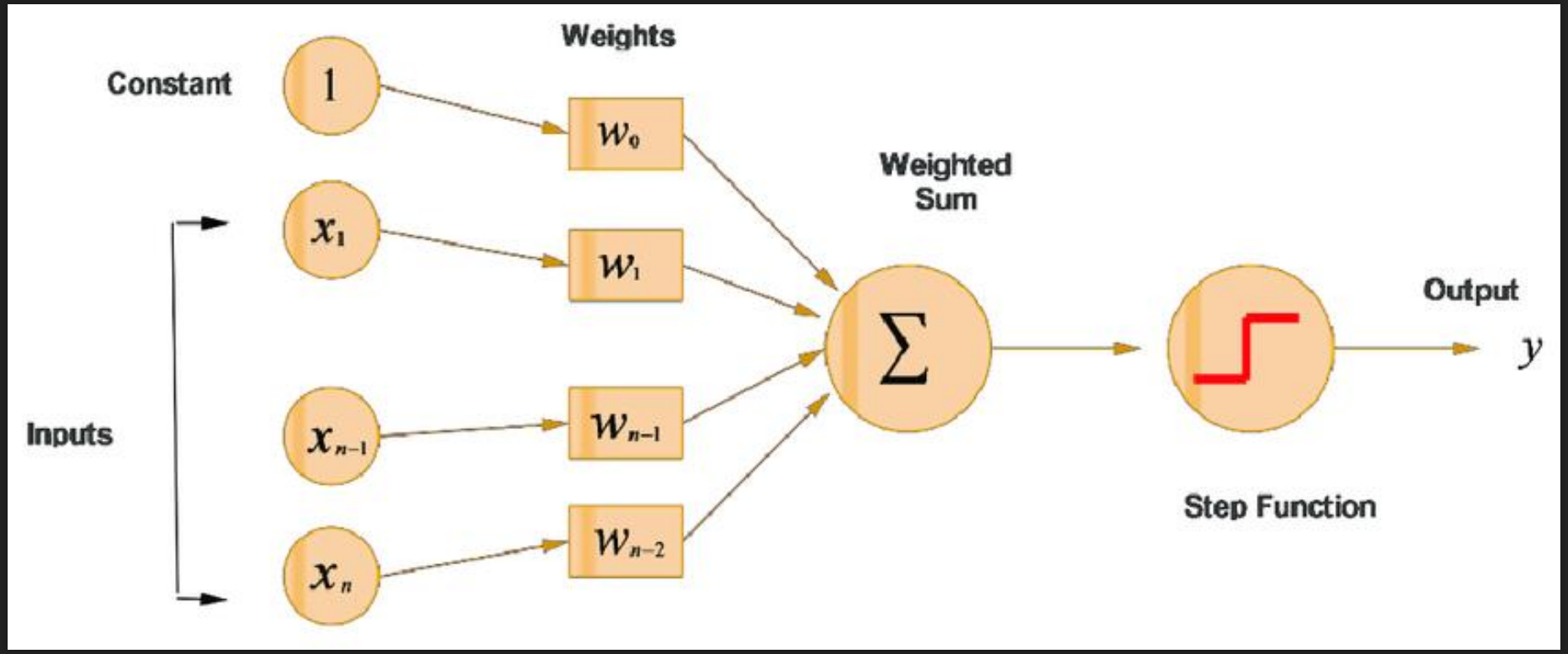
Artificial Neural Network



Artificial Neural Network



Artificial Neural Network



The learning process of a single layer with one neuron

- Let's assume in a problem, the output values can be either +50 or -50.
- Also, let vector X represent our input features. Vector W denotes the weights learned by the neural network.
- The activation function, based on a specific mechanism, maps numbers greater than 10 to +50 and numbers less than or equal to 10 to -50.

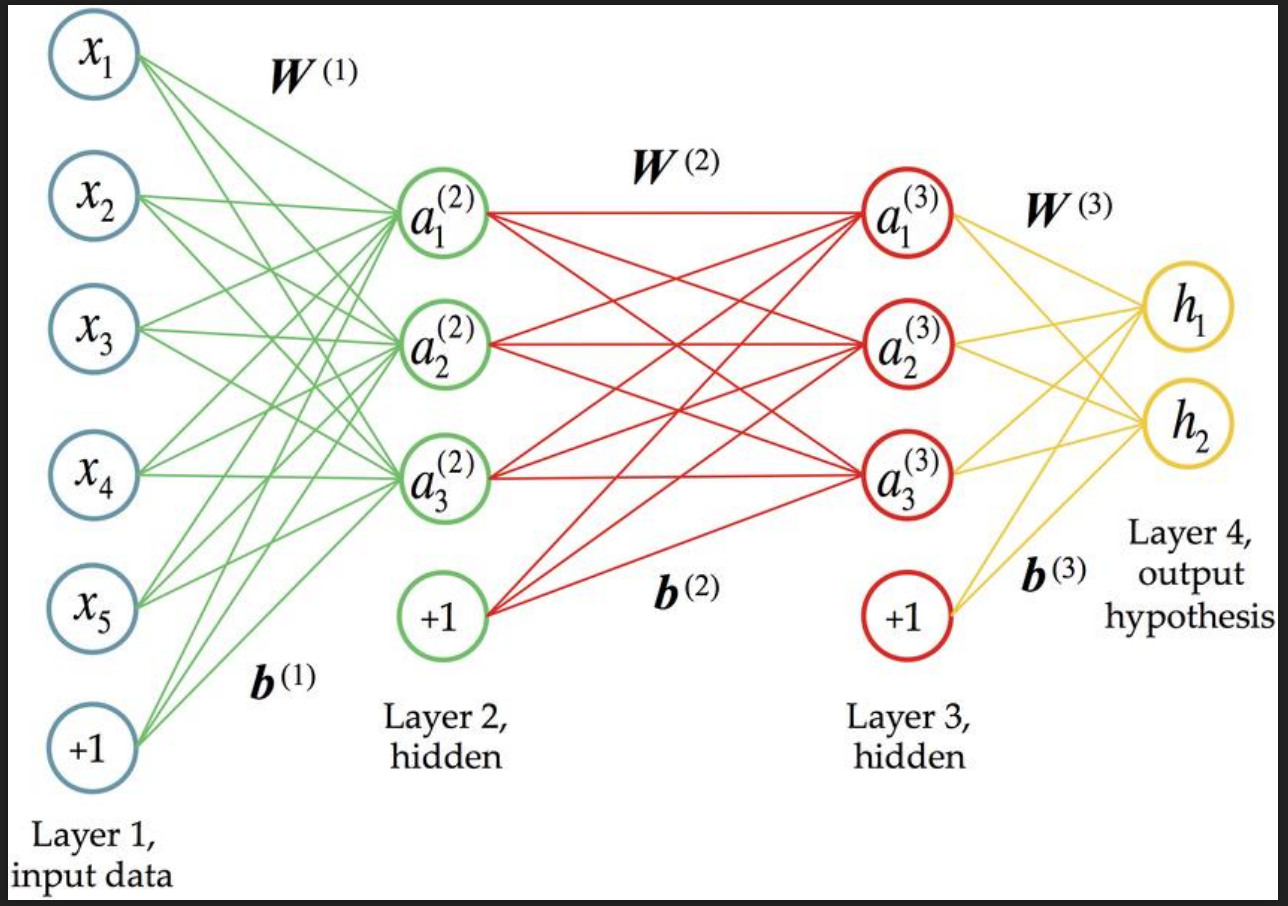
X = [8 , 6 , 2 , 1]

W = [1 , 4 ,3 , 4]

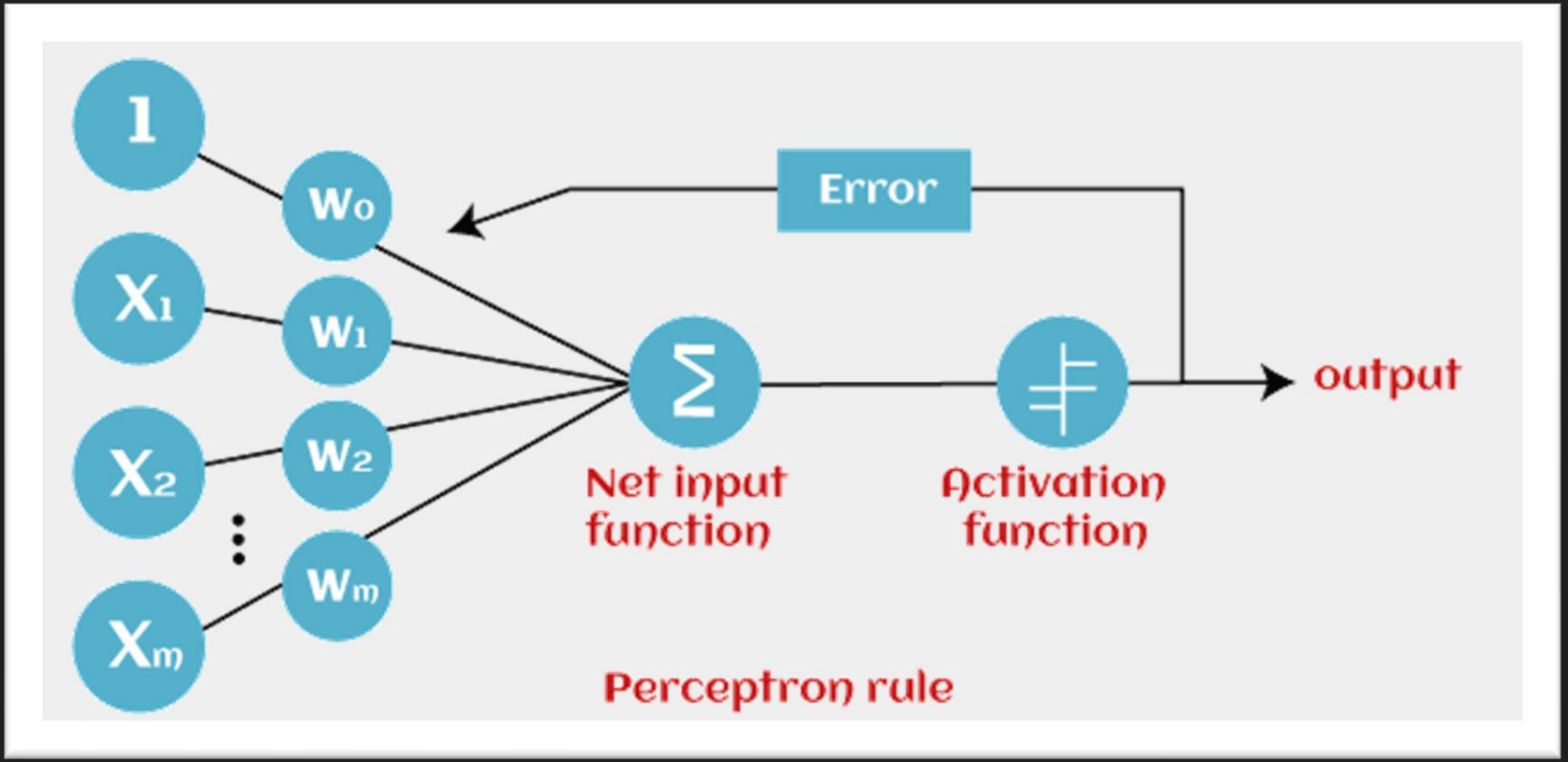
42 = 4*1 + 3*2 + 4*6 + 1*8

Act_Func (42) = +50

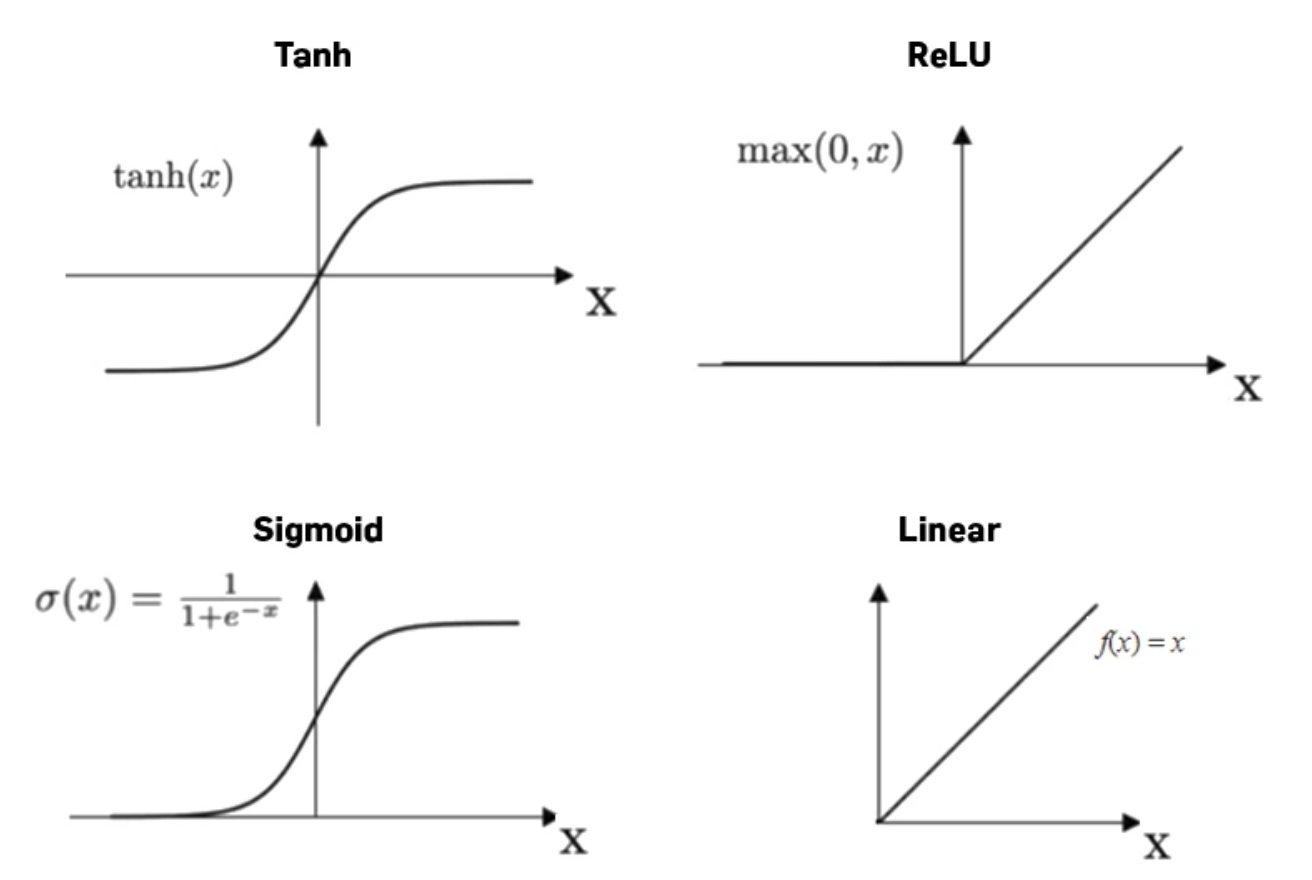
Learning process with multiple layers

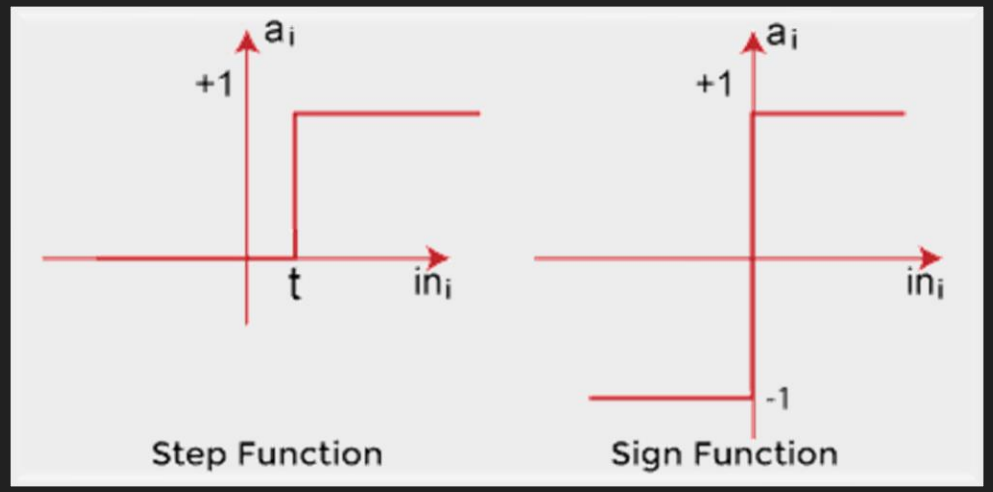


Error Backpropagation



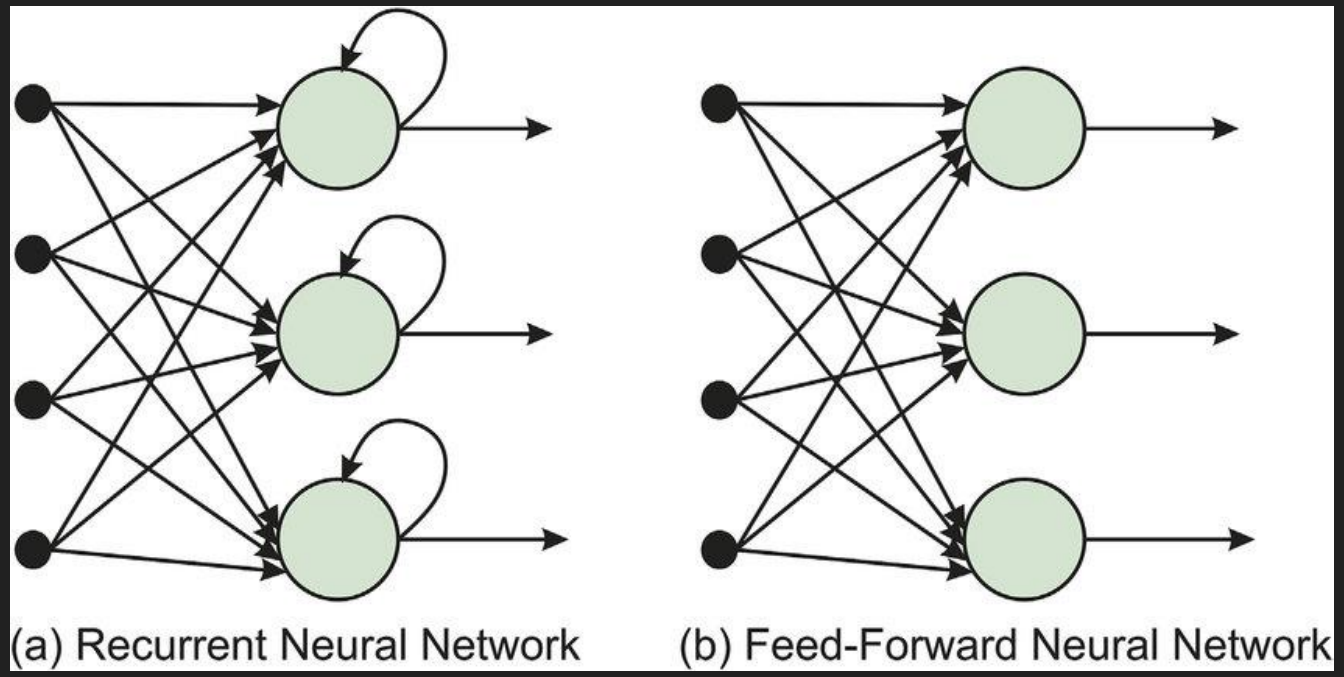
Examples of activation functions

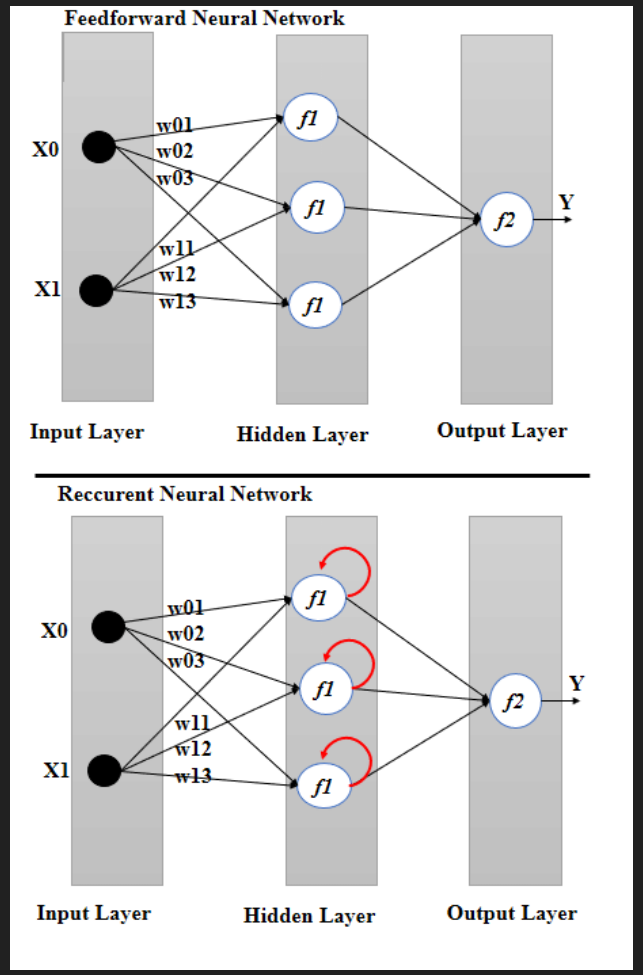




Types of neural networks

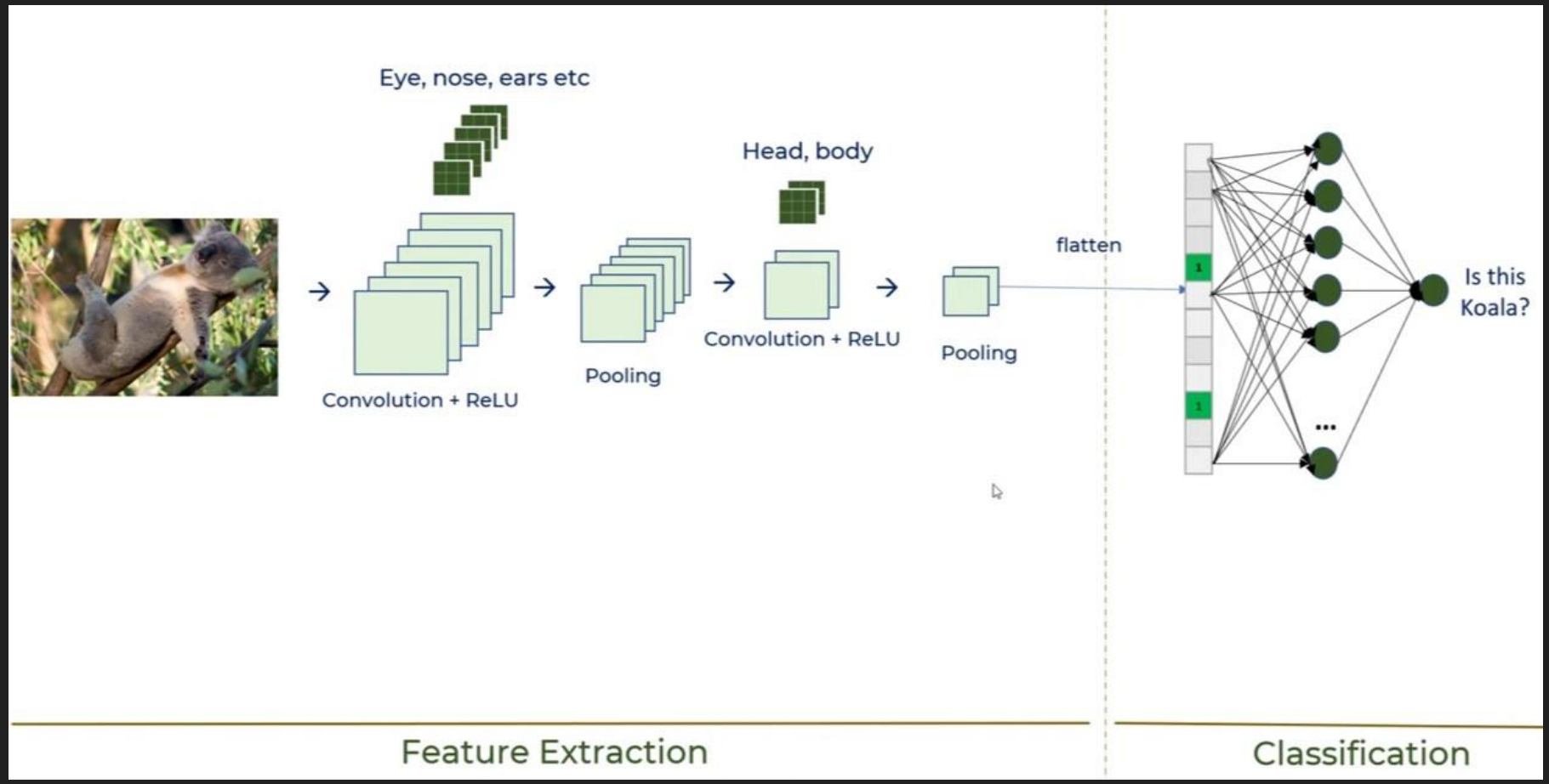
- The difference between RNN and Feed-Forward (MLP)





Types of neural networks

General schematic of CNN



A mostly complete chart of

Neural Networks

- Backfed Input Cell
- Input Cell
- Noisy Input Cell
- Hidden Cell
- Probablistic Hidden Cell
- Spiking Hidden Cell
- Output Cell
- Match Input Output Cell
- Recurrent Cell
- Memory Cell
- Different Memory Cell
- Kernel
- Convolution or Pool

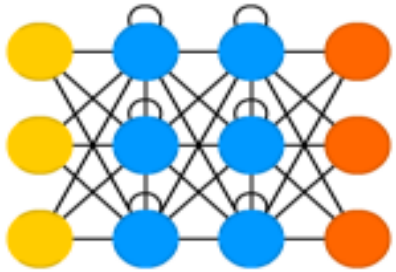
Perceptron (P)

Feed Forward (FF)

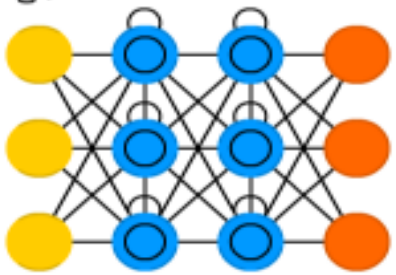
Radial Basis Network (RBF)

Deep Feed Forward (DFF)

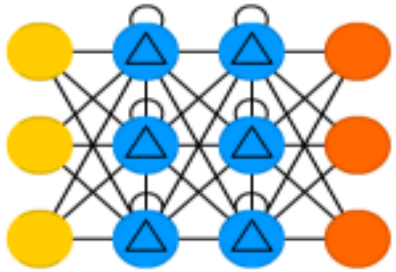
Recurrent Neural Network (RNN)



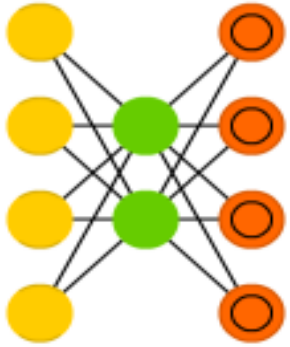
Long / Short Term Memory (LSTM)



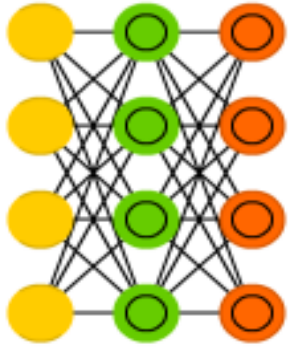
Gated Recurrent Unit (GRU)



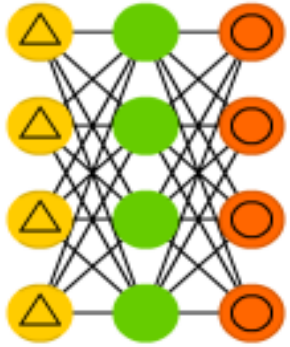
Auto Encoder (AE)



Variational AE (VAE)



Denoising AE (DAE)



Sparse AE (SAE)

Additional resources

https://machinelearningmastery.com/neural-networks-crash-course/
https://machinelearningmastery.com/when-to-use-mlp-cnn-and-rnn-neural-networks/
https://towardsdatascience.com/multilayer-perceptron-explained-with-a-real-life-example-and-python-code-sentiment-analysis-cb408ee93141

The End

Thank you for your attention. I wish you pleasant times ahead.