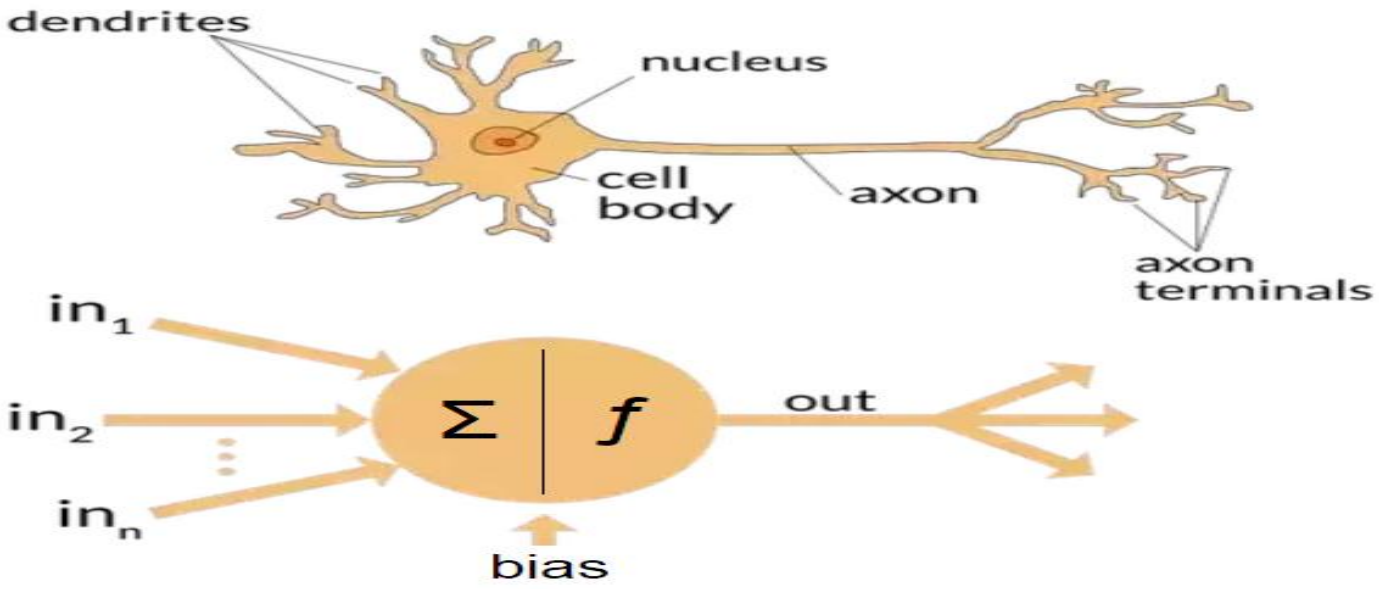
Overview

1. Biological inspiration
2. Artificial neurons and neural networks
3. Application

INTRODUCTION
TO



Why Artificial Neural Networks?

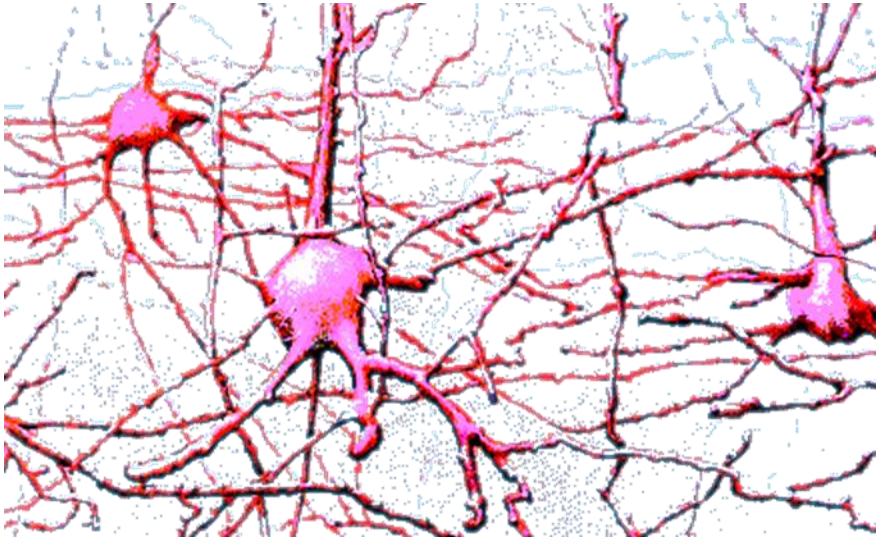
- There are two basic reasons why we are interested in building artificial neural networks (ANNs):

- **Technical viewpoint:** Some problems such as character recognition or the prediction of future states of a system require massively parallel and adaptive processing.

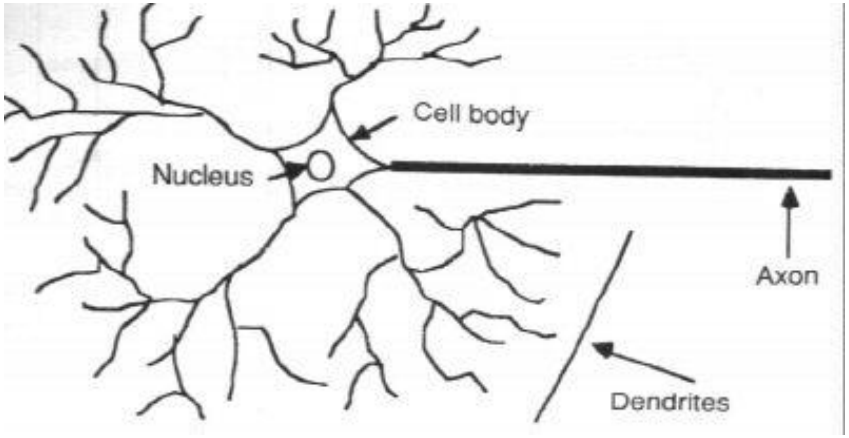
- **Biological viewpoint:** ANNs can be used to replicate and simulate components of the human (or animal) brain, thereby giving us insight into natural information processing.

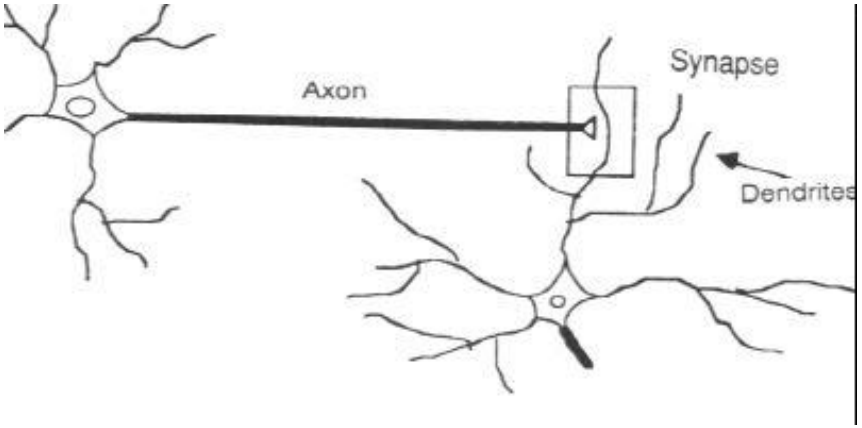
Biological Neuron

- Animals are able to react adaptively to changes in their external and internal environment, and they use their nervous system to perform these behaviours.
- An appropriate model/simulation of the nervous system should be able to produce similar responses and behaviours in artificial systems.



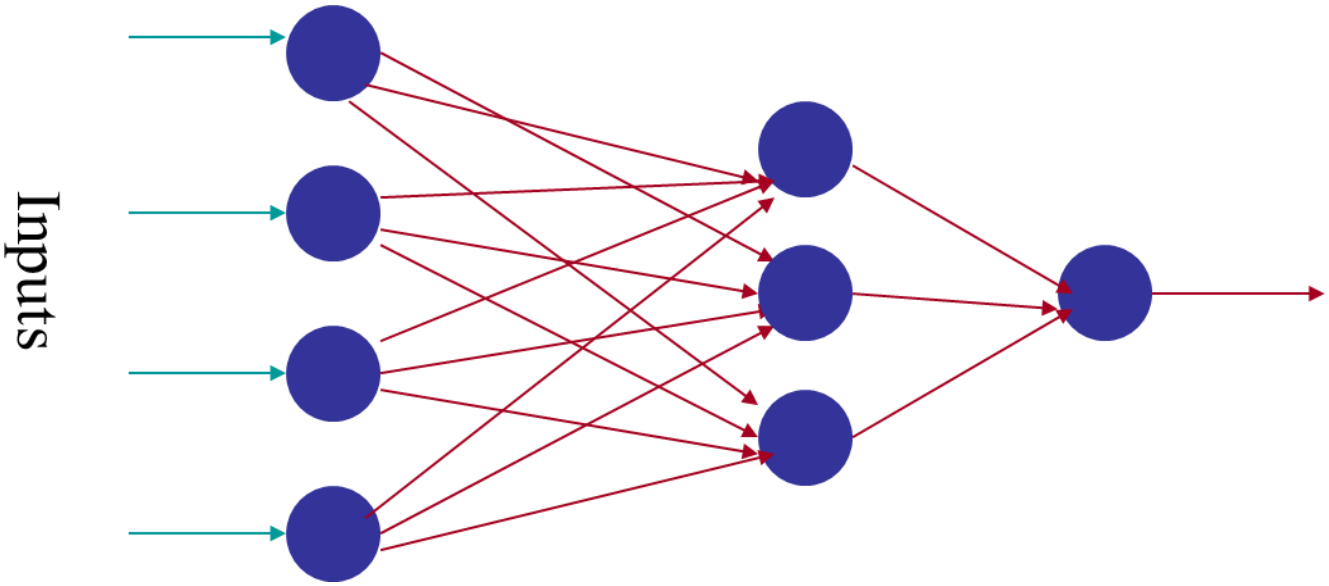
Biological Neuron





The information transmission happens at the synapses.

Artificial neural networks

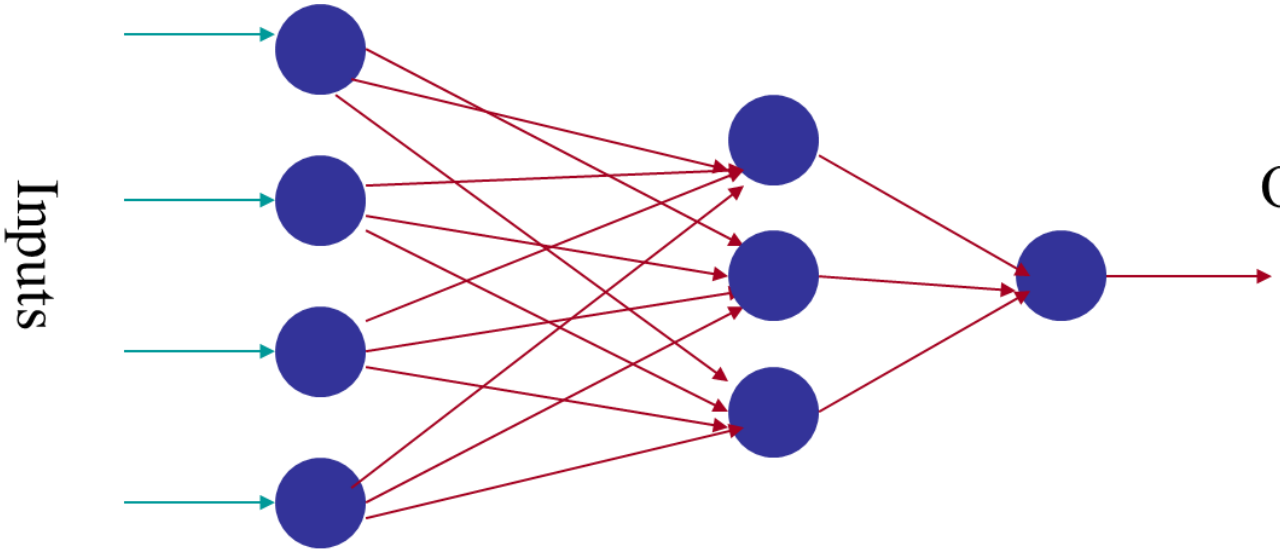


An artificial neural network is composed of many artificial neurons that are linked together according to a specific network architecture. The objective of the neural network is to transform the inputs into meaningful outputs.

Artificial Neural Network

- Artificial Neural Network is an efficient computing system whose central theme is borrowed from the
- analogy of biological neural networks. ANNs are also named as “artificial neural systems,” or “parallel
- distributed processing systems,” or “connectionist systems.” ANN acquires a large collection of units that are
- interconnected in some pattern to allow communication between the units. These units, also referred to as
- nodes or neurons, are simple processors which operate in parallel

Neural network mathematics



$$y_1^1 = f(x_1, w_1^1)$$
$$y_2^1 = f(x_2, w_2^1)$$
$$y_3^1 = f(x_3, w_3^1)$$
$$y_4^1 = f(x_4, w_4^1)$$

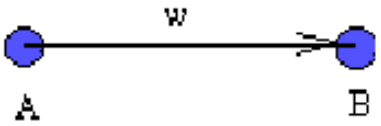
$$y^1 = \begin{pmatrix} y_1^1 \\ y_2^1 \\ y_3^1 \\ y_4^1 \end{pmatrix}$$

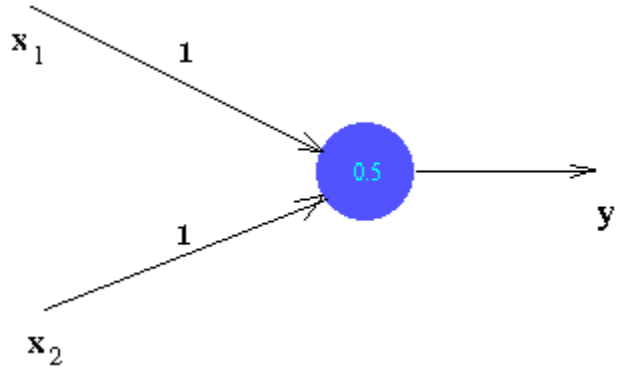
$$y_1^2 = f(y^1, w_1^2)$$
$$y_2^2 = f(y^1, w_2^2)$$
$$y_3^2 = f(y^1, w_3^2)$$

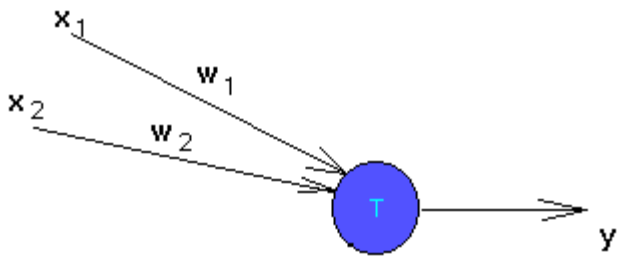
$$y^2 = \begin{pmatrix} y_3^2 \\ y_3^2 \\ y_3^2 \end{pmatrix}$$

$$y_{Out} = f(y^2, w_1^3)$$

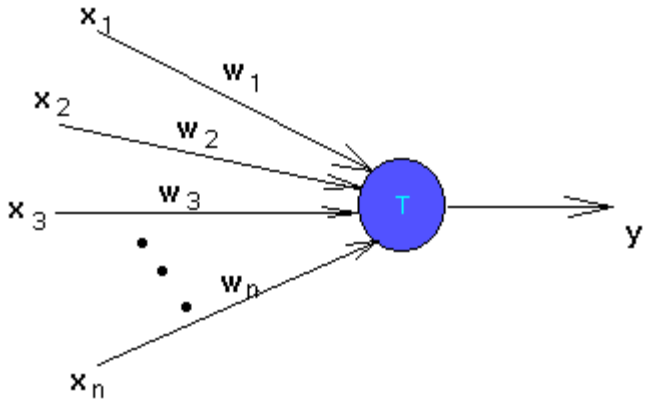
Artificial neurons Neuron





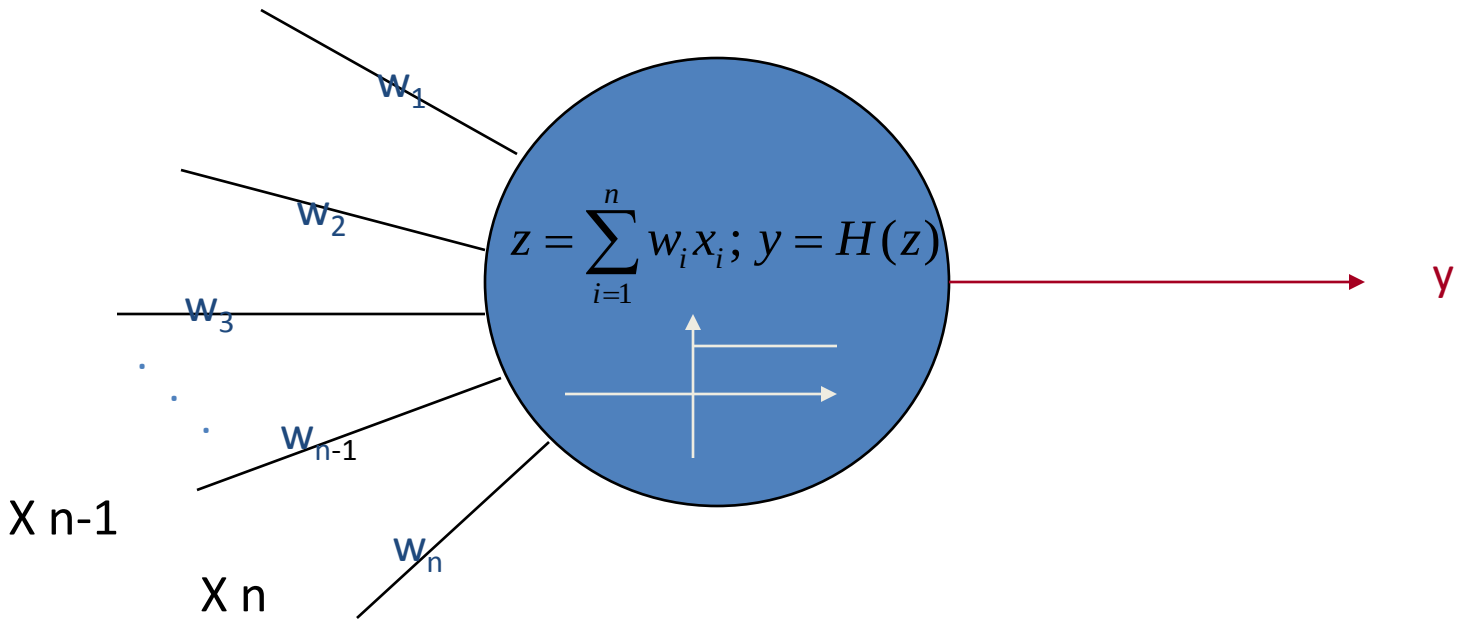


y = w1*x1 + w2*x2
Take X=1, ==> y=w1*x1+w2 ??



Artificial neurons

- X1
- X2
- X3



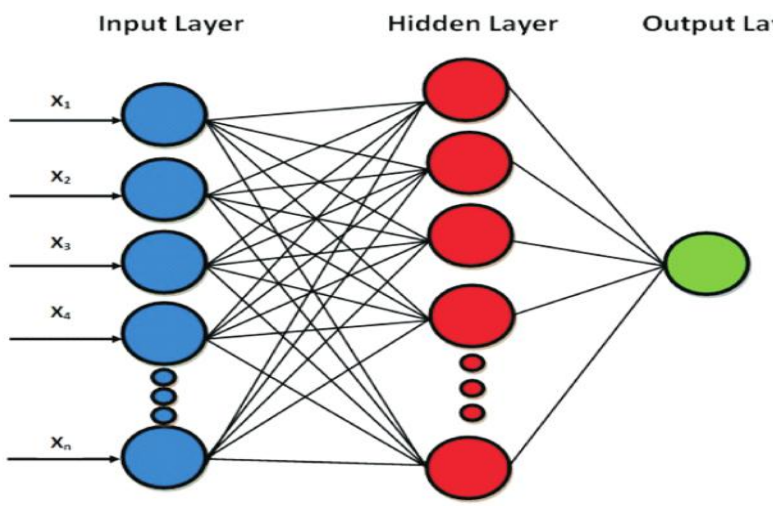
one possible model

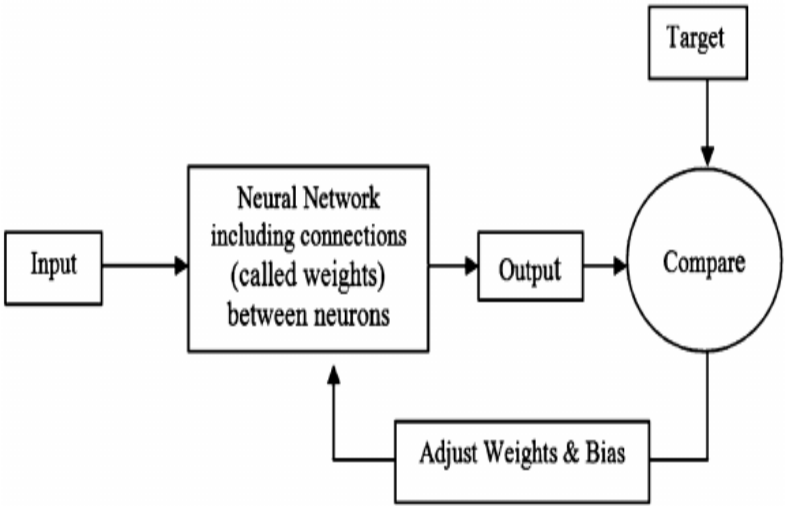
Artificial Neural Network and Biological Neural Network

Biological Neural Network (BNN)	Artificial Neural Network (ANN)
Soma	Node
Dendrites	Input
Synapse	Weights or Interconnections
Axon	Output

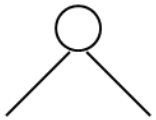
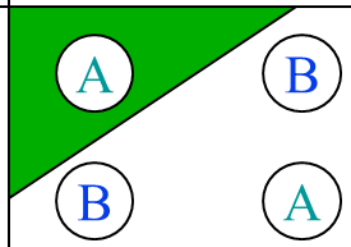
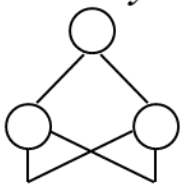
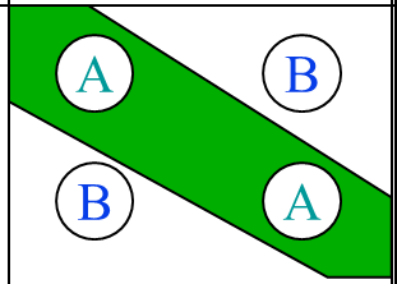
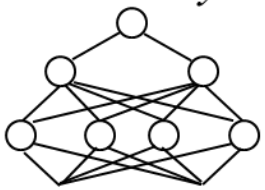
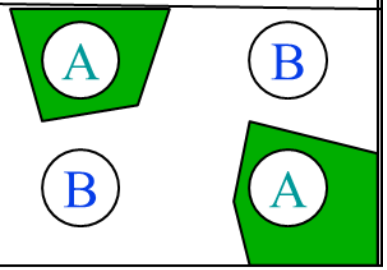
Artificial Neural Network Model

- Artificial neural network modal Showing adjust of neural network





Multi-Layer Perceptron Application

Structure	*Types of Decision Regions*	*Result*
Single-Layer 	*Half Plane Bounded By Hyperplane*	
Two-Layer 	*Convex Open Or Closed Regions*	
Three-Layer 	Abitrary (Complexity Limited by No. of Nodes)	

Conclusion

NN have some disadvantages such as:

1. Preprocessing
2. Results interpretation by high dimension
3. Learning phase/Supervised/Non Supervised