

Contents

- .Introduction to Neural Network
- .Neurons
- .Activation Function
- .Types of Neural Network
- .Learning In Neural Networks
- .Application of Neural Network
- .Advantages of Neural Network
- .Disadvantages Of Neural Network

Neural Networks

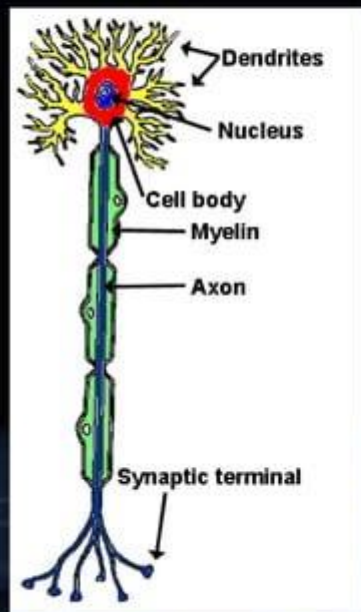
- A method of computing, based on the interaction of multiple connected processing elements.
- A powerful technique to solve many real world problems.
- The ability to learn from experience in order to improve their performance.
- Ability to deal with incomplete information

Basics Of Neural Network

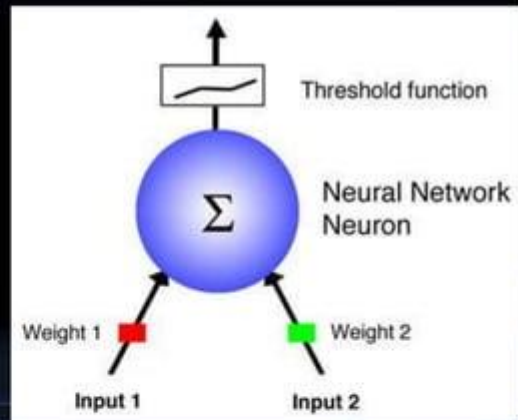
- Biological approach to AI
- Developed in 1943
- Comprised of one or more layers of neurons
- Several types, we'll focus on feed-forward and feedback networks

Neurons

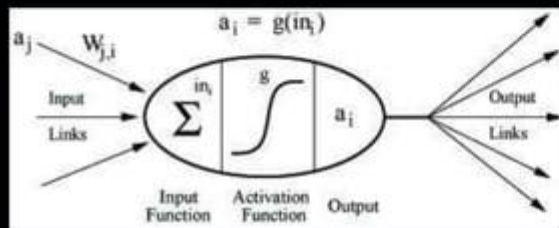
Biological



Artificial



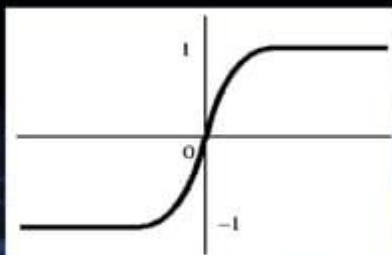
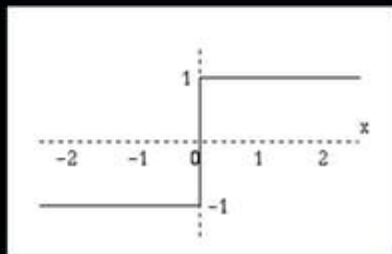
Neural Network Neurons



- Receives n-inputs
- Multiplies each input by its weight
- Applies activation function to the sum of results
- Outputs result

Activation Functions

- Controls when unit is "active" or "inactive"
- Threshold function outputs 1 when input is positive and 0 otherwise
- Sigmoid function
 $= 1 / (1 + e^{-x})$



Types of Neural Networks

Neural Network types can be classified based on following attributes:

- **Connection Type**

- Static (feedforward)
- Dynamic (feedback)

- **Topology**

- Single layer
- Multilayer
- Recurrent

- **Learning Methods**

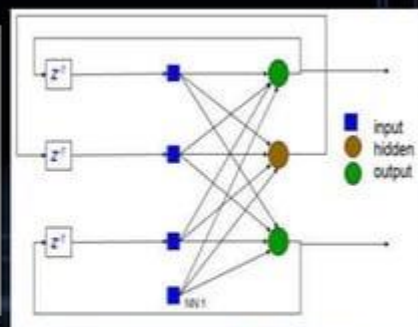
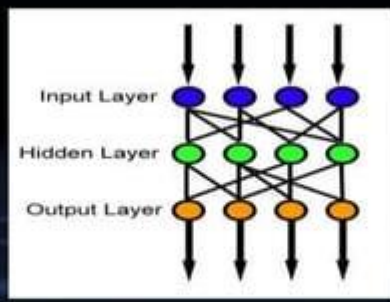
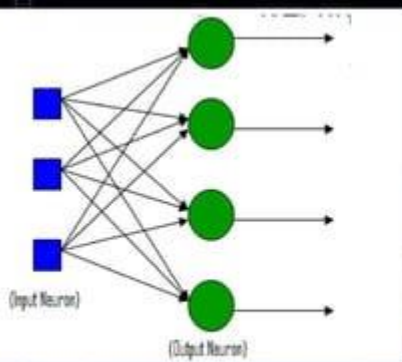
- Supervised
- Unsupervised
- Reinforcement

Classification Based On Connection Types

- Static (Feedforward)
- Dynamic (Feedback)

Classification Based On Topology

- Single layer
- Multilayer
- Recurrent



(unit delay operator z^{-1} implies dynamic system)

Classification Based On Learning Method

- Supervised
- Unsupervised
- Reinforcement

Supervised learning

- Each training pattern: input + desired output
- At each presentation: adapt weights
- After many epochs convergence to a local minimum

Unsupervised Learning

- No help from the outside
- No training data, no information available on the desired output
- *Learning by doing*
- Used to pick out structure in the input:
 - Clustering
 - Reduction of dimensionality → compression
- *Example:* Kohonen's Learning Law

Reinforcement learning

- Teacher: training data
- The teacher scores the performance of the training examples
- Use performance score to shuffle weights 'randomly'
- Relatively slow learning due to 'randomness'

Neural Network Applications

- Pattern recognition
- Investment analysis
- Control systems & monitoring
- Mobile computing
- Marketing and financial applications
- Forecasting - sales, market research, meteorology

Advantages :

- A neural network can perform tasks that a linear program can not.
- When an element of the neural network fails, it can continue without any problem by their parallel nature.
- A neural network learns and does not need to be reprogrammed.
- It can be implemented in any application.
- It can be implemented without any problem

Disadvantages :

- The neural network needs training to operate.
- The architecture of a neural network is different from the architecture of microprocessors therefore needs to be emulated.
- Requires high processing time for large neural networks.

Conclusions

- Neural networks provide ability to provide more human-like AI
- Takes rough approximation and hard-coded reactions out of AI design (i.e. Rules and FSMs)
- Still require a lot of fine-tuning during development