Neural Networks

Why Neural Network?

- The conventional computers are good for- fast arithmetic and does what programmer's programs, ask them to do.
- The conventional computers are not so good for – interacting with noisy data or data from environment, massive parallelism, fault tolerance, and adapting to circumstances.
- The neural network system help where we can not formulate an algorithmic solution or where we can get lots of example of the behaviour we require.
- Neural networks are a form of multiprocessor computer system, with
    - Simple processing elements,
    - a high degree of interconnections,
    - simple scalar message, and
    - adaptive interaction between the elements.

What is Neural Network?

- A neural net is an artificial representation of the human brain that tries to simulate its learning process.

- Traditionally, the word neural network is referred to a network of biological neurons in the nervous system that process and transmit information.

- ANN is an interconnected group of artificial neurons that uses a mathematical model or computational model for information processing based on a connectionist approach to computation.

Fundamental of Neural Network

- ANN, like people learn by example, which makes them very flexible and powerful.

- Learning in biological system involves adjustment to the synaptic connections that exist between the neurons. This is true for ANN as well.

- An ANN is configured for a specific application, such as pattern recognition or data classification, through learning process.

Resemblance with Brain

- Neural networks resemble the brain in two respects:

1. The network acquires knowledge from its environment using a learning process (algorithm)
2. Synaptic weights, which are interneuron connection strengths, are used to store the learned information.

Advantages of Neural networks

- Neural networks, with their remarkable ability to derive meaning from complicated or imprecise data, could be used to extract patterns and detect trends that are too complex to be noticed by either humans or other computer techniques.

- A trained neural network could be thought of as an "**expert**" in a particular category of information it has been given to analyze.

- **Adaptive learning:** An ANN is endowed with the ability to learn how to do tasks based on the data given for training or initial experience.

- **Self-organization:** An ANN can create its own organization or representation of the information it receive during learning time.

- **Nonlinearity**
- **Input-Output Mapping**
- **Adaptivity:** Weights (parameters) can be retrained with new data.

- **Fault tolerance** via redundant information coding
- **Real time operation**: ANN computations may be carried out in parallel.
- **Neurobiological Analogy**

- Human brains are fast, powerful, fault tolerant, and use massively parallel computing.

- Neurobiologists try to explain the operation of human brains using artificial neural networks.

- Engineers use neural computation principles for solving complex problems.

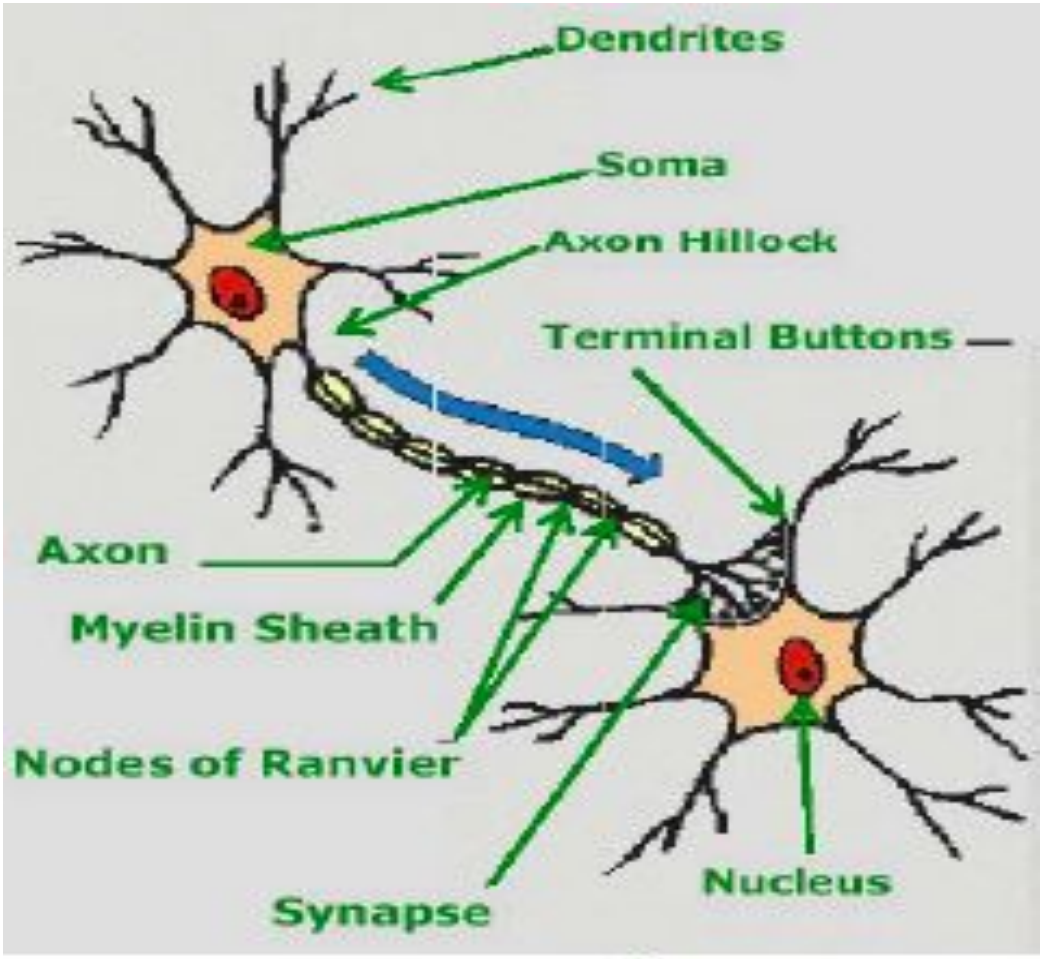
Biological Neuron Model

- The human brain consists of a large number, more than a billion of neural cells that process information.
- Neural cells does not regenerate.
- Each cell works like a simple processor.
- The massive interaction between cells and their parallel processing only makes the brain's abilities possible.

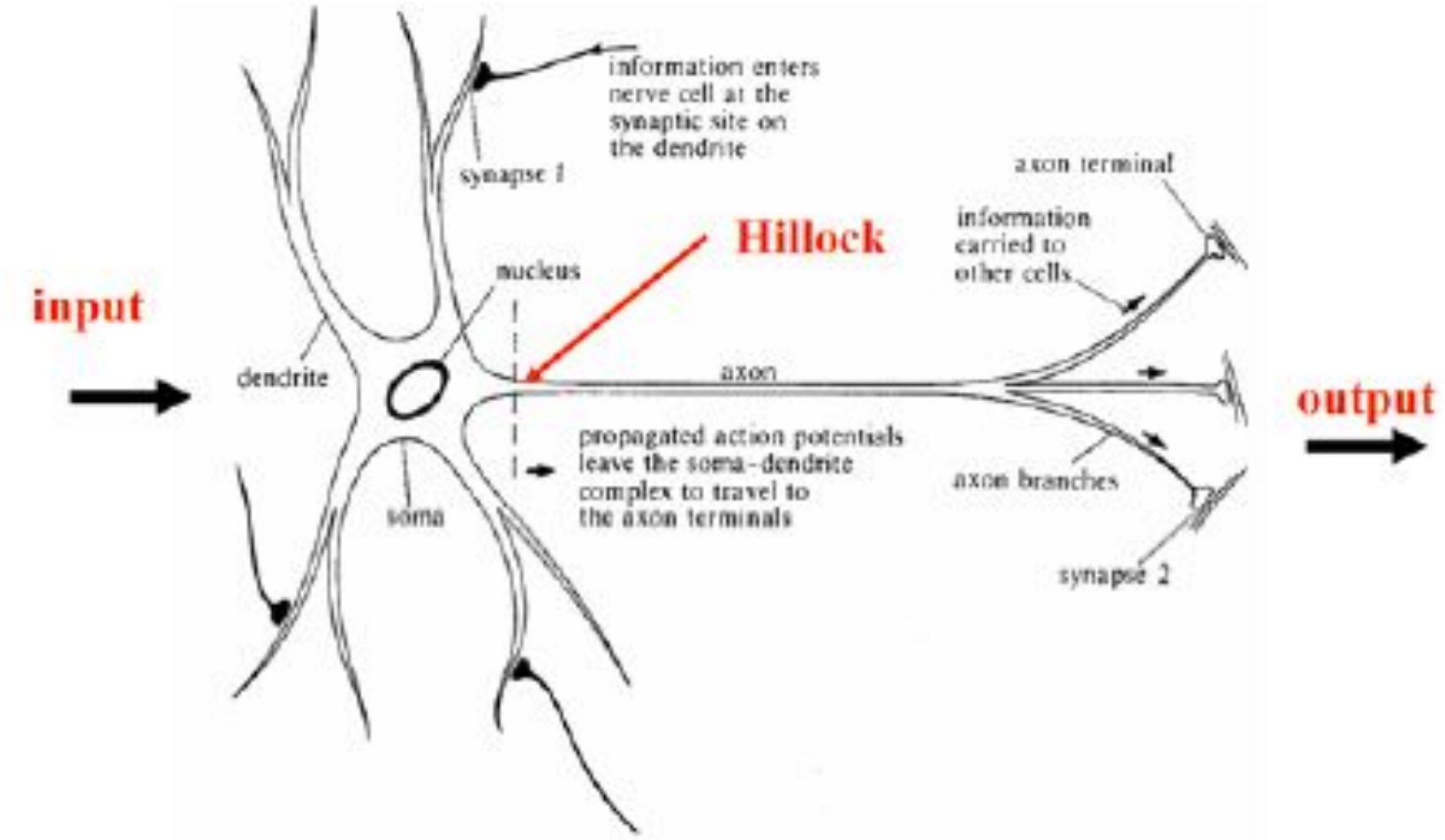
Dendrites: are branching fibers that extend from the cell body or soma.

- **Soma or cell body:** It contains the nucleus and other structures, support chemical processing and production of neurotransmitters.
- **Axon:** Is a singular fiber carries information away from the soma to the synaptic sites of other neurons (dendrites and somas), muscles, or glands.
- **Synapse:** is the point of connection between two neurons or a neuron and a muscle or gland. Electrochemical communication between neurons takes place at these junctions.
- **Terminal buttons:** are the small knobs at the end of an axon that release chemicals called neurotransmitters.

Biological Neuron Model



Information flow in a Neural Cell



Information flow in a Neural Cell

- **Dendrites** receive activation from other neurons.
- **Soma** processes the incoming activation and converts them into output activations.
- **Axons** act as transmission lines to send activation to other neurons.
- **Synapse** the junctions allow signal transmission between the axons and dendrites.
- The process of transmission is by diffusion of chemicals called neuro-transmitters.

Terminology relationship b/w biological and artificial neurons

Biological neuron	Artificial neuron
Cell	Neuron
Dendrites	Weight or interconnections
Soma	Net input
Axon	Output

Application Scope

- Air Traffic Control
- Data Mining, Cleaning and Validation,
- Expert Consultants
- Employee Hiring
- Fraud Detection
- Voice recognition
- Weather Prediction etc.