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Neural Network

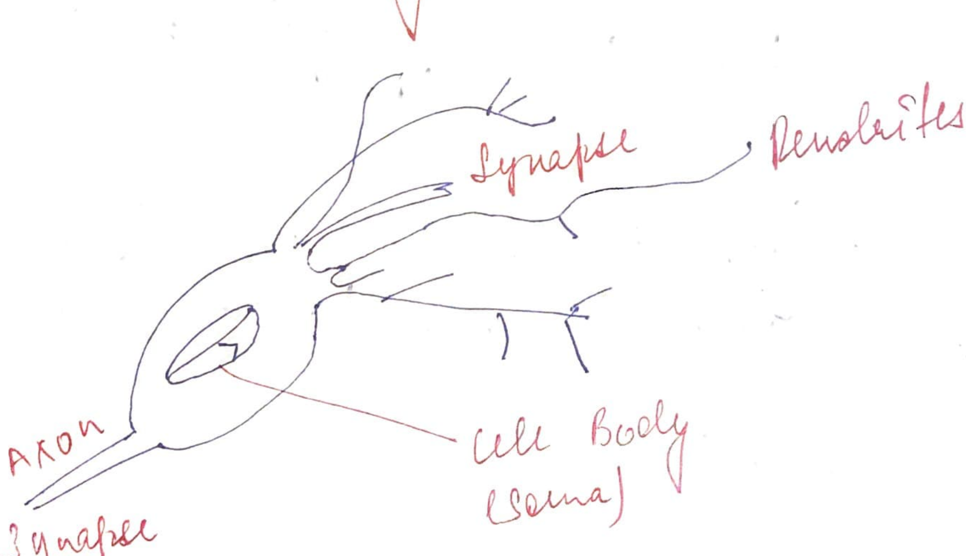
- It can be taught to perform complex tasks and do not require programming as conventional computers.
- They are massively parallel, extremely fast and intrinsically fault - tolerant
- They learn from experience, generalize from examples, and are able to extract essential characteristics from noisy data.
- They require significantly less development time and can respond to situations unspecified or not previously envisaged.
- A Neural Network is made up of no. of processing elements called Neurons, whose interconnections are called Synapses.

Each Neuron accepts inputs from either the External world or from the Outputs of other Neuron

- Output Signals form all the Neurons eventually propagate their effect across the entire Network to the final layer where the Results can be Output to the Real world.

- The Synapses have a processing value or weight, which is learn during training of the Network.
- The Functionality and power of the Network primarily depends on the no. of Neurons in the Network, the interconnectivity patterns or topology, and the Value of the Weights assigned to each Synapse.

Structure of a Neuron



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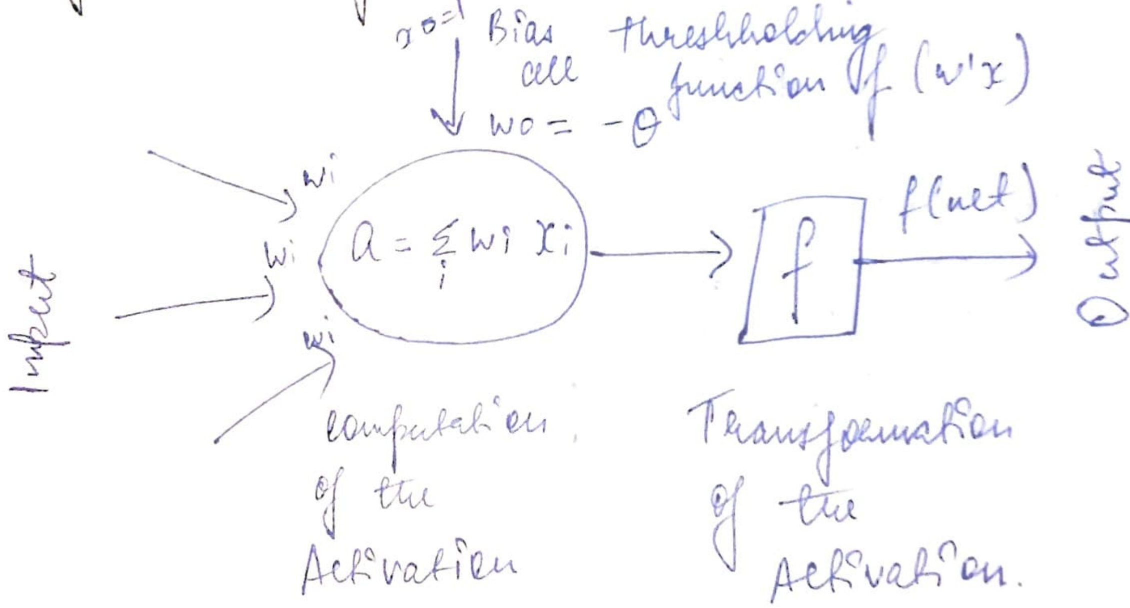
Model of an Artificial Neuron



The Basic Neural Unit

- The Human Brain is a highly complex structure viewed as massive, highly interconnected network of ~~high~~ simple processing elements called Neurons
- Every component of the model bears a direct anology to the actual constituents of a Biological Neuron

and hence it is termed as Artificial Neuron.

- It is the model which forms the basis of Artificial Neural Networks
- A unit collects information provided by other units (or by external world) to which it is connected with weighted connections called Synapses.

$$O = f(w^t x) \text{ or}$$

$$O = f(\Sigma w_i x_i)$$

. Where w_i is the weight vector defined as

$$W \triangleq [w_1 w_2 \dots w_n]^t$$

and x is the input vector

Associated Terminologies of Biological and Artificial Neural Net

Biological Neural N/w	Artificial Neural N/w
Cell Body	Neuron
Dendrites	Weights or Interconnection
Soma	Net Input
Axon	Output

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McCULLOCH - PITTS NEURON MODEL

[∴ O/p y]

$$f(net) = \begin{cases} 1 \text{ if } \sum_{i=1}^{n} w_i x_i k \geq T \\ 1 \text{ if } \sum_{i=1}^{n} w_i x_i k < T \end{cases}$$

Excitatory connections have +ve weights &
inhibitory connections have -ve weights

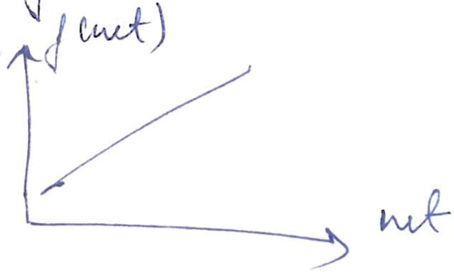
Activation functions and Types of Activation fn

- It is used to calculate the output response of Neuron.
- The sum of the weighted input signal is applied with an Activation to obtain the Response.
- They may be linear as well as non-linear
- The Non-linear functions are used in a multilayer net.

Types of Activation fn :

1) Identity Element

The linear neuron or linear network, it is also called as Identity fn $f(net) = net$.



2) Sigmoidal fn : these functions are usually S-shaped curves. The Hyperbolic & logistic fn's are commonly used. These are used in multilayer nets like Backpropagation network, Radial basis fn, etc.

The 2 main types of sigmoidal fn are:

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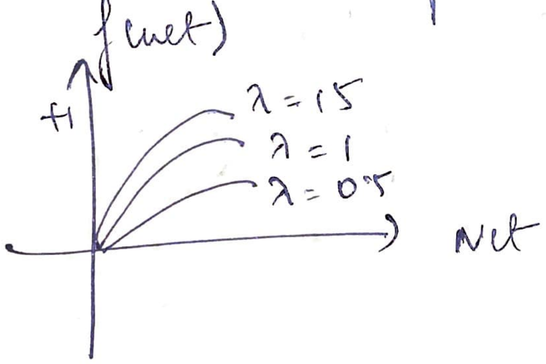
Binary sigmoidal functions

- also known as logistic f.n.
- Ranges from 0 to 1

$$f(net) = \frac{1}{1+\exp^{-\lambda net}}$$

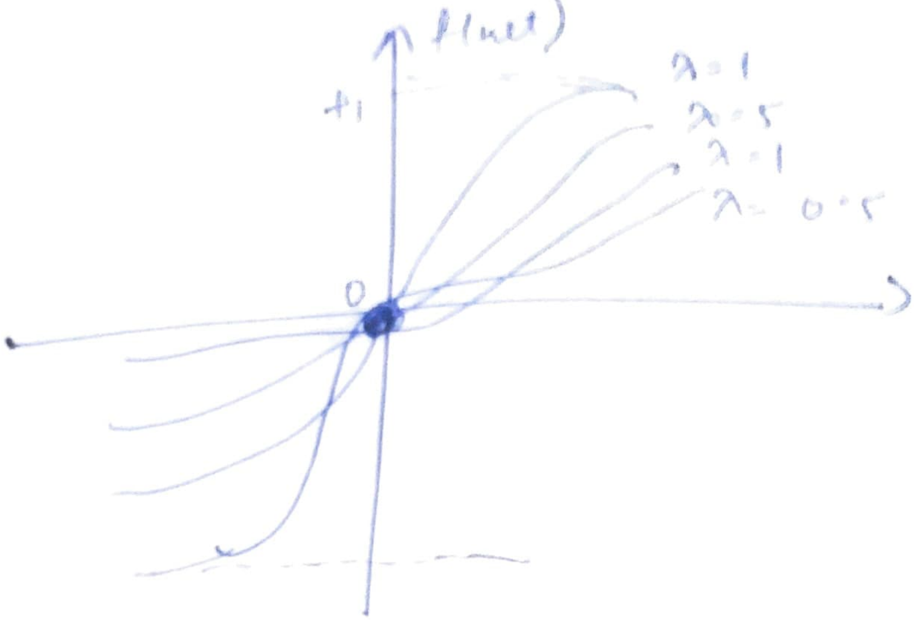
Where λ is the steepness parameter



Bipolar sigmoidal function

- Range b/w +1 and -1
- Fn is related to the hyperbolic tangent f.n.

$$f(net) = \frac{2}{1+e^{-\lambda net}} - 1$$



Signum function :

Hardlimiter activation function

$$f(net) = \begin{cases} +1 & net \geq 0 \\ -1 & < 0 \end{cases}$$

$f(net) = Sgn(net)$ or Sign(net

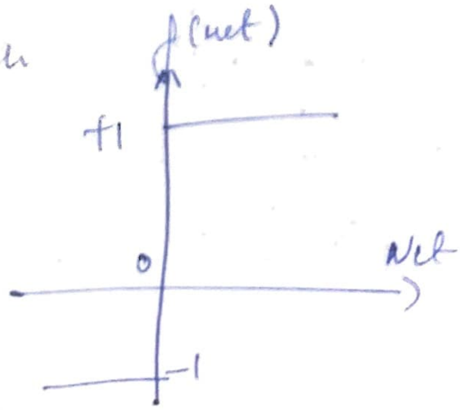
Sgn(net) is the signum fn.

Binary step function

There are 2 types of Binary step fn.

Bipolar Binary : Hardlimiter fn

$$f(net = \begin{cases} +1 & u \geq T \\ -1 & u < T \end{cases}$$



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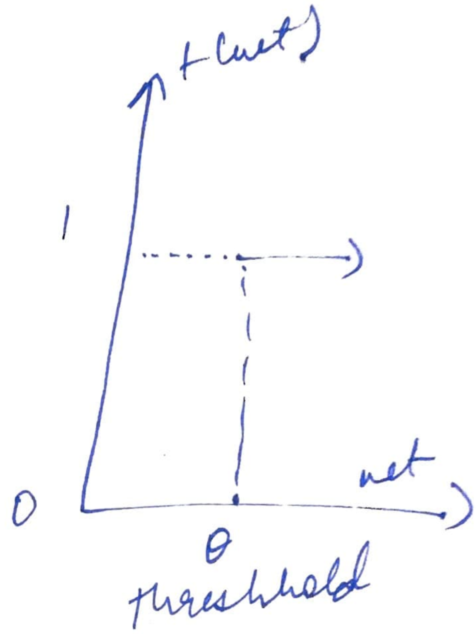
Unipolar Binary f^n

$$f(net) = \begin{cases} +1 & net \geq 0 \\ 0 & net < 0 \end{cases}$$

$$f(net) = \begin{cases} +1 & net \geq T \\ 0 & net < T \end{cases}$$



Bias : It acts exactly as a weight on a connection from a unit whose activation is always 1

Threshold : the Threshold T is factor which is used ~~eta~~ calculating the Activation of the given net.