Artificial Neuron.

Q.3] Explain structure of biological neuron.

→ (1) In living organisms, the brain is the control unit of neural network and it has different subunits that take care of vision, senses, movement and hearing.

(2) The brain is connected with a dense network of nerves to the rest of the body's sensors & actors.

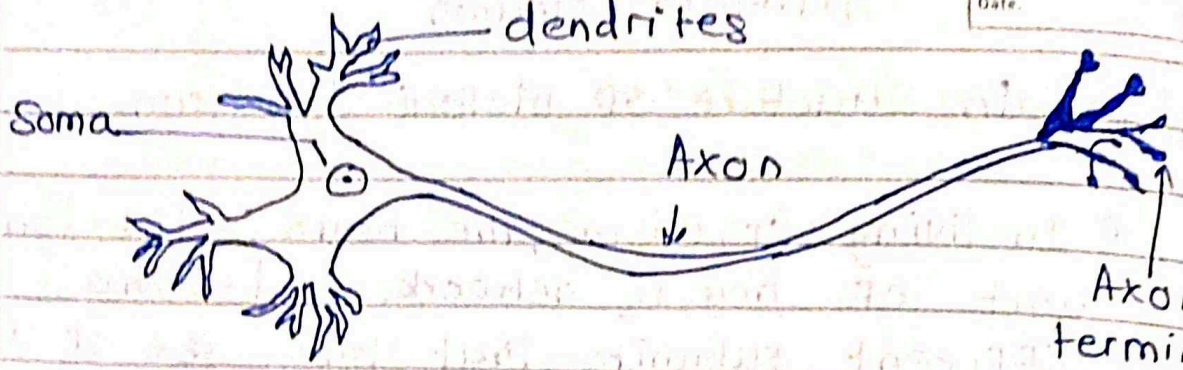
(3) There are approx. 10^{11} neurons in the brain. & these are building blocks of complete central nervous system of living body.

(4) The neuron is fundamental building block of neural networks. In the biological systems, a neuron is a cell just like any other cell of the body, which has a DNA code & is generated in same way as the other cells.

(5) Though it might have different DNA, the fun^n is similar in all organisms. A neuron comprises three major parts: the cell body, the dendrites and axon. The dentrites are like fibers branched in different directions and are connected to many cells in that cluster.

(6) Dendrites receive the signals from surrounding neurons and the axon transmits the signal to the other neurons. At the ending terminal of the axon, the contact with the dendrite is made through a synapse.

(7) Axon is a long fiber that transport the output signal as electric impulses along its length. each neuron has one axon. Axon pass impulses from one neuron to another like a domino effect.



Neuron

Q.1] Derive eqn. for back propagation tech in multilayer neuron network.

→ (1) Backpropagation is supervised learning algorithm for ~~to~~ training multi-layer neuron network.

(2) The backpropagation alg. looks for minimum value of error function in weight space using tech. called gradient descent.

(3) Below are steps involved in backpropagation:-

Step 1 : Forward propagation
Step 2 : Backward propagation
Step 3 : Putting all the values together and calculating the updated weight value.

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1. 2] Explain activation fun^n. used in artificial neuron network.

→ ① Activation function decides whether a neuron should be activated or not by calculating weighted sum and further adding bias with it.

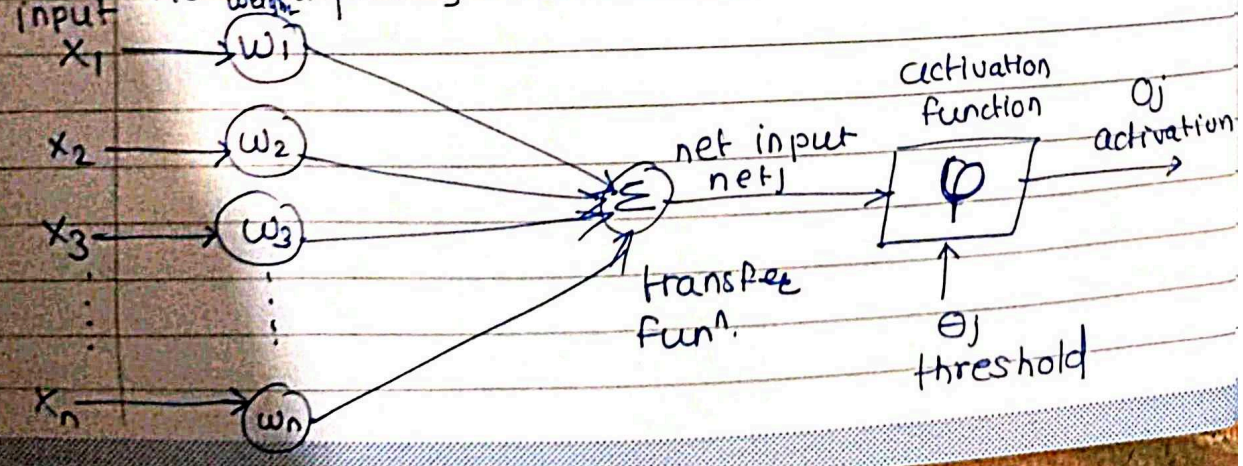
② The purpose of activation fun^n is to introduce non-linearity into the output of neuron.

③ Neural network has neurons that work in correspondence of weight, bias & their respective activative fun^n.

④ In a neural-network, we would update weights and biases of the neurons on the basis of error at the output. This process is called back-propagation.

⑤ Activation fun^n. make the back-propagation possible since the gradient are supplied along with the error to update the weights & biases.

⑥ To put in simple terms, an artificial neuron calculates the weighted sum of its inputs & adds as bias as show in fig.



⑦ Types of activation Functions :-

① Mathematically

$$\text{net input} = \Sigma(\text{weight} * \text{input}) + \text{bias}$$

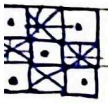
⑧ Types of activation functions :-

1. Step function
2. Sigmoid function
3. ReLU
4. Leaky ReLU

Clustering

Q. agglomarative hierarchical clustering.

→ 1. This approach is also known as bottom-up approach.
2. In this, we start with each object forming a separate cluster.
3. It keeps on merging the objects or clusters that are class to one another.
4. It keeps on doing so until all of the clusters are merged into one or until the termination condition holds.



steps:-
1. compute distance matrix from object features.
2. set each object as a independant cluster.
3. Iterate until number of cluster in equal to 1.
   a) merge two classes clusters
   b) update distance matrix

Assume we have six objects A, B, C, D, E, F each having two attribute X_1 & X_2. Distance betn. two objects is calculated using euclidian distance formula using their attributes X_1 & X_2
For exp distance betn. A & B can be calculated as:

$$d(A,B) = \sqrt{(x_{A1} - x_{B1})^2 + (x_{A2} - x_{B2})^2}$$

For exp distances betn ~~A & B can be cal~~ A = (1, 1) & B = (1.5, 1.5)

is computed as -

$$d_{AB} = \sqrt{(1-1.5)^2 + (1-1.5)^2}$$

$$= 0.7071$$

Q. How similarity is measured in clustering tech.

→ clustering is tech. to group objects based on distance or similarity clustering algorithm seek to segment the entire data set into relatively homogeneous subgroups as clusters, where

- The similarity of the records within the cluster is maximized.
- The similarity of records outside this cluster is minimized.

For measuring similarity distance metric is used Most common distance metric is euclidian distance other distances can also be used.

distance functions

euclidian $\sqrt{\sum_{i=1}^{k} (x_i - y_i)^2}$

Manchattan $\sum_{i=1}^{k} |x_i - y_i|$

Minkowski $\left[\sum_{i=1}^{k} (|x_i - y_i|)^2\right]^{1/2}$

where $x = x_1, x_2 \dots x_m$ & $y = y_1, y_2 \dots y_m$ represent the m attribute values of two records.

Q. How centroid is calculated for multiple att data in clustering. OR
How cluster quality is measured in k-mean clustering.

→ k-mean alg.

Step1: select number of clusters k the data set should be patitioned into.
Step 2: Randomly assign k records to be initial cluster.
step 3: calculate centroid of the cluster.
Step 4: For each record, find the nearest cluster center & add the record to that cluster.
step 5: For each of the k cluster, find the cluster centroid & update the location of each cluster center to the new value of the centroid.
step 6: Repeat step 4-5 until convergence or termination.

Centroid of the cluster is the mean value of the elements in the cluster.

Q. K-mean clustering algorithm.

→ K-means clustering intends to partition n objects into k clusters in which each object belongs to the cluster with the nearest mean.
This method produces exactly k diff. clusters of greatest possible destination.
The best no. of clusters k leading to the greatest seperation (distance) is not known as priori & must be computed from the data.

Steps same as centroid.