1. **Describe the structure of an artificial neuron. How is it similar to a biological neuron? What are its main components?**

An artificial neuron is a connection point in an artificial neural network. Artificial neural networks, like the human body's biological neural network, have **a layered architecture** and each network node (connection point) has the capability to process input and forward output to other nodes in the network.

**Similarities**:

* **Biological neural networks process information in parallel**; this is also true of artificial neural networks.
* Learning in biological neural networks is through past experiences which improve their performance level; this is also true of artificial neural networks

There are three main components: **an input later, a processing layer, and an output layer**.

1. **What are the different types of activation functions popularly used? Explain each of them.**

The different types of activation functions popularly used are :

- Sigmoid function :

Sigmoid is a widely used activation function. It is of the form : f(x)=1/(1+e-x)

* Tanh function : it is very similar to the sigmoid function. It is actually just a scaled version of the sigmoid function. tanh(x)=2sigmoid(2x)-1
* ReLU function : The ReLU function is non linear, which means we can easily backpropagate the errors and have multiple layers of neurons being activated by the ReLU function. f(x) = max(0,x)
* Leaky ReLU : Leaky ReLU function is nothing but an improved version of the ReLU function.

It can be defined as-  
f(x)= ax, x<0  
f(x)= x, x>=0

* Softmax : The softmax function is also a type of sigmoid function but is handy when we are trying to handle classification problems. It is ideally used in the output layer of the classifier where we are actually trying to attain the probabilities to define the class of each input.
  1. Explain, in details, Rosenblatt’s perceptron model. How can a set of data be classified using a simple perceptron?

Rosenblatt perceptron is **a binary single neuron model**. The inputs integration is implemented through the addition of the weighted inputs that have fixed weights obtained during the training stage. If the result of this addition is larger than a given threshold θ the neuron fires.

* 1. Use a simple perceptron with weights *w*0, *w*1, and *w*2 as −1, 2, and 1, respectively, to classify data points (3, 4); (5, 2); (1, −3); (−8, −3); (−3, 0).

1. **Explain the basic structure of a multi-layer perceptron. Explain how it can solve the XOR problem.**
2. A fully connected multi-layer neural network is called a Multilayer Perceptron (MLP). It has 3 layers including one hidden layer. If it has more than 1 hidden layer, it is called a deep ANN. An MLP is a typical example of a feedforward artificial neural network.
3. **What is artificial neural network (ANN)? Explain some of the salient highlights in the different architectural options for ANN.**
4. An artificial neuron network (neural network) is **a computational model that mimics the way nerve cells work in the human brain**. Artificial neural networks (ANNs) use learning algorithms that can independently make adjustments - or learn, in a sense - as they receive new input.
5. ANN is made of three layers namely **input layer, output layer, and hidden layer/s**. There must be a connection from the nodes in the input layer with the nodes in the hidden layer and from each hidden layer node with the nodes of the output layer. The input layer takes the data from the network.
6. Explain the learning process of an ANN.

Learning process in ANN mainly depends on four factors, they are: **The number of layers in the network (Single-layered or multi-layered)** **Direction of signal flow (Feedforward or recurrent)** **Number of nodes in layers**: The number of node in the input layer is equal to the number of features of the input data set.

1. Explain, with example, the challenge in assigning synaptic weights for the interconnection between neurons? How can this challenge be addressed?
2. Explain, in details, the backpropagation algorithm. What are the limitations of this algorithm?

* Back-propagation is the essence of neural net training. It is **the practice of fine-tuning the weights of a neural net based on the error rate (i.e. loss) obtained in the previous epoch (i.e. iteration)**. Proper tuning of the weights ensures lower error rates, making the model reliable by increasing its generalization.
* The biggest disadvantages of backpropagation are: **Backpropagation could be rather sensitive to noisy data and irregularity**. The performance of backpropagation relies very heavily on the training data. Backpropagation needs a very large amount of time for training.

1. Describe, in details, the process of adjusting the interconnection weights in a multi-layer neural network.
2. One main part of the algorithm is adjusting the interconnection weights. This is done using a technique termed as **Gradient Descent.**
3. What are the steps in the backpropagation algorithm? Why a multi-layer neural network is required?
4. **Step 1: Inputs X, arrive through the preconnected path.** Step 2: The input is modeled using true weights W. Weights are usually chosen randomly. Step 3: Calculate the output of each neuron from the input layer to the hidden layer to the output layer.
5. Write short notes on:
   * + 1. Artificial neuron

Neural networks, also known as artificial neural networks (ANNs) or simulated neural networks (SNNs), are **a subset of machine learning and are at the heart of deep learning algorithms**.

* + - 1. Multi-layer perceptron

An MLP is characterized by several layers of input nodes connected as a directed graph between the input and output layers. MLP uses backpropogation for training the network.

* + - 1. Deep learning

a type of machine learning based on artificial neural networks in which multiple layers of processing are used to extract progressively higher level features from data.

* + - 1. Learning rate

the learning rate regulates the weights of our neural network concerning the loss gradient.

1. Write the difference between:-
   * + 1. Activation function vs threshold function

**The activation function compares the input value to a threshold value**. If the input value is greater than the threshold value, the neuron is activated. It's disabled if the input value is less than the threshold value, which means its output isn't sent on to the next or hidden laye

* + - 1. Step function vs sigmoid function

Step Function is one of the simplest kind of activation functions. In this, we consider a threshold value and **if the value of net input say y is greater than the threshold then the neuron is activated**

* + - 1. Single layer vs multi-layer perceptron

A Multi Layer Perceptron (MLP) contains one or more hidden layers (apart from one input and one output layer). **While a single layer perceptron can only learn linear functions, a multi layer perceptron can also learn non - linear functions**.