1. **What is the function of a summation junction of a neuron? What is threshold activation function?**

**Ans:** The summation junction in a neuron calculates the weighted sum of the input signals. The threshold activation function determines whether the neuron will fire or not based on the input it receives. If the weighted sum is above a certain threshold, the neuron fires, otherwise, it remains inactive.

1. **What is a step function? What is the difference of step function with threshold function?**

**Ans:** A step function is a mathematical function that returns one for input values above a certain threshold and zero otherwise. The primary difference between a step function and a threshold function lies in their mathematical representations, with the step function being discontinuous, while the threshold function can be continuous.

1. **Explain the McCulloch–Pitts model of neuron.**

**Ans:** The McCulloch–Pitts model of neuron is a simplified mathematical model inspired by biological neurons. It represents a binary threshold logic gate, where inputs are summed, and if the sum exceeds a threshold, the neuron fires, producing an output signal of 1; otherwise, it produces an output signal of 0.

1. **Explain the ADALINE network model.**

**Ans:** ADALINE (Adaptive Linear Neuron) is an early single-layer neural network model that utilizes a linear activation function. It is used for binary classification tasks and can adjust its weights through a variation of the Widrow-Hoff learning rule, also known as the delta rule.

1. **What is the constraint of a simple perceptron? Why it may fail with a real-world data set?**

**Ans:** The constraint of a simple perceptron is its inability to solve problems that are not linearly separable. Real-world datasets often contain non-linear relationships, making a simple perceptron insufficient for handling complex patterns and leading to misclassifications.

1. **What is linearly inseparable problem? What is the role of the hidden layer?**

**Ans:** A linearly inseparable problem refers to a dataset that cannot be separated into classes using a single straight line or hyperplane. The hidden layer in a neural network enables the representation of complex, non-linear relationships in the data, allowing the network to learn and capture intricate patterns that a single-layer perceptron cannot.

1. **Explain XOR problem in case of a simple perceptron.**

**Ans:** The XOR problem is a classic example that demonstrates the limitations of a simple perceptron. Since the XOR problem is not linearly separable, a simple perceptron fails to learn the appropriate decision boundary, resulting in inaccurate predictions.

1. **Design a multi-layer perceptron to implement A XOR B.**

**Ans:** A multi-layer perceptron for A XOR B would require at least one hidden layer to capture the non-linear relationship. It can consist of two input nodes, one or more hidden layers with suitable activation functions, and one output node with an appropriate activation function.

1. **Explain the single-layer feed forward architecture of ANN.**

**Ans:** A single-layer feedforward architecture of an artificial neural network consists of an input layer, a hidden layer, and an output layer. The input layer receives the input data, the hidden layer processes the information, and the output layer produces the final output.

1. **Explain the competitive network architecture of ANN.**

**Ans:** Competitive networks are a type of artificial neural network where neurons compete to become active, typically exhibiting a winner-takes-all behavior. They are often used for tasks **such as vector quantization and feature mapping.**

1. **Consider a multi-layer feed forward neural network. Enumerate and explain steps in the backpropagation algorithm used to train the network.**

**Ans:** Initialize network weights.

Forward pass to calculate the output.

Calculate the error between the predicted output and the true output.

Backward pass to update the weights based on the error using gradient descent.

Repeat steps 2-4 for multiple iterations or until convergence.

1. **What are the advantages and disadvantages of neural networks?**

**Ans:** Advantages: Neural networks can learn complex patterns, handle noisy data, and generalize well to unseen data. They can also be used for various tasks, including classification, regression, and pattern recognition.

Disadvantages: They require a large amount of data for training, are computationally expensive, and can be prone to overfitting. They also lack transparency in their decision-making process.

1. **Write short notes on any two of the following:**
   * 1. **Biological neuron**
     2. **ReLU function**
     3. **Single-layer feed forward ANN**
     4. **Gradient descent**
     5. **Recurrent networks**

**Ans:** Biological Neuron: A biological neuron is the fundamental unit of the nervous system, responsible for processing and transmitting information. It consists of a cell body, dendrites, and an axon, and it communicates with other neurons through electrical and chemical signals.

ReLU Function: ReLU (Rectified Linear Unit) is an activation function that returns zero for negative inputs and the input value for positive inputs. It is widely used in deep learning due to its ability to mitigate the vanishing gradient problem.

Gradient Descent: Gradient descent is an optimization algorithm used to minimize the loss function by adjusting the model parameters iteratively in the direction of the steepest descent of the loss. It is commonly employed in training neural networks.

Single-Layer Feed Forward ANN: A single-layer feedforward artificial neural network is a simple neural network that consists of only an input layer and an output layer. It is limited to learning linearly separable patterns and cannot handle complex relationships between variables.

Recurrent Networks: Recurrent neural networks (RNNs) are a type of artificial neural network that has connections that form directed cycles. They are commonly used in tasks that involve sequential data, such as natural language processing and time series prediction.