Q1. An Artificial Neural Network (ANN) is a computational model inspired by the structure and function of the human brain. It consists of interconnected units called neurons that process information in layers to recognize patterns and make decisions.

Resemblance to the Human Brain:

- Neurons: ANN neurons mimic biological neurons by processing signals and passing outputs.

- Synapses (Weights): Connections between ANN neurons have adjustable weights, similar to how synapses strengthen or weaken in the brain.

- Learning: Like the brain, ANNs learn through experience (training) using techniques like gradient descent and backpropagation.

- Parallel Processing: ANN processes multiple inputs simultaneously, just as the brain does with sensory data.

Q2. A neuron is an information processing unit. It consits of: inputs associated with weights, sum of inputs and an acitvation function

Q3. apply input data to input layer and initialize small values weights minimize error according to difference between desired signal and output signal assign the test vector the class that has smallest error

Q4. Initialize weights of the neurons randomly

Repeat until convergence:

For each input vector x:

Find Best Matching Unit (BMU):

$BMU = \text{argmin} \, || x - w_i ||$

Update weights of BMU and neighbors:

$w_i = w_i + \eta * (x - w_i)$

Reduce learning rate (η) and neighborhood size over time

Explanation:

- **BMU Selection:** Finds the neuron closest to input xxx.
- **Weight Update:** Moves BMU and its neighbors closer to xxx.

- **Decay:** Learning rate and neighborhood size shrink over iterations.

Q5. Backpropagation (Backward Propagation of Errors) is the core algorithm behind deep learning. It optimizes neural networks by minimizing loss using gradient descent.

Forward Propagation: The input is processed through multiple layers, where each neuron applies a weighted sum and an activation function to generate an output.

Error Calculation: The loss function (e.g., Mean Squared Error, Cross-Entropy) measures the difference between predicted and actual outputs.

Backward Propagation:

Compute gradients using the chain rule of differentiation.

Adjust weights using Gradient Descent or advanced optimizers like Adam or RMSprop.

Iterative Learning: The process repeats until convergence, allowing the model to learn complex patterns from data.

Backpropagation powers modern AI systems, enabling deep neural networks to achieve human-level accuracy in tasks like image recognition, speech processing, and NLP.