Exam Date & Time: 13-Jan-2024 (02:30 PM - 05:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

V SEMESTER B.TECH END SEMESTER MAKE UP EXAMINATIONS, JAN 2024

ARTIFICIAL NEURAL NETWORK [CSE 3175]

Marks: 50 **Duration: 180 mins.**

A

Answer all the questions.

Instructions to Candidates: Answer ALL questions Missing data may be suitably assumed

1) Describe a neural network with a single neuron? Mention technical and biological viewpoint on significance of building artificial neural network. (4)

A) Evaluate and compare the effectiveness of four learning rules in neural network training, substantiating your analysis with mathematical expressions that capture the unique characteristics of each rule. (4)

B) Consider a single perceptron with sign activation function. The perceptron is represented by weight vector[0.4 -0.3 0.1] and bias Θ=0. if the input vector to the perceptron is X=[0.2 0.6 0.5].Find out the output of the perceptron (2)

C)

2) How do you determine when the K-means algorithm has converged to the final cluster assignments? performing K-means clustering with K=3 on a dataset with the following data points: [3, 5], [4, 5], [3, 4], [5, 3], [7, 5], [8, 5], [9, 4]. initialize the cluster centroids as follows: Centroid 1: [3, 5], Centroid 2: [5, 3], Centroid 3: [9, 4]. Calculate the assignment of each data point to the nearest centroid. n: Using the assignments from the previous step, calculate the new cluster centroids. (4)

A)

B) Mention 3 tasks for which multilayer perceptron can be used.

A simple MLP with one input layer, one hidden layer with two neurons, and one output layer with a single neuron. The input values are [1, 2], and the initial weights and biases are as follows:

Hidden Layer Weights: [[0.1, 0.2], [0.3, 0.4]]

Hidden Layer Biases: [0.5, 0.6]

Output Layer Weights: [0.7, 0.8]

Output Layer Bias: 0.9

Calculate the output of the MLP after the feedforward process with a sigmoid activation (4)

function in the hidden layer and a linear activation in the output layer

C) How does the delta rule handle the problem of adjusting weights in a neural network to minimize errors? In the context of the delta rule, what is the significance of the learning rate, and how can it affect the convergence of the training process? (2)

3) How is the Radial Basis Function expressed mathematically? Mention the advantage and disadvantage of Radial basis function. How does the concept of cooperation among neurons in Self-Organizing Maps (SOMs) facilitate the process of unsupervised learning? Elaborate on the mechanisms by which neighboring neurons collaborate to organize and represent input data? (4)

A)

B) What are the main similarities and differences between feed–forward neural networks and self–organizing maps? (2)

C) Explain the competitive learning process in a Self-Organizing Map (SOM). Consider a 2x2 SOM with input data vectors: [1, 0], [0, 1], [1, 1]. Initialize the weight vectors to w11=[0,0], w12=[1,1], w21=[1,0], w22=[0,1]. Show the updated weight vectors after 1 iteration of the SOM learning algorithm with a learning rate of 0.5 (4)

4) What is a Recurrent Neural Network (RNN)? How are connections dynamically driven in a Recurrent Neural Network? (2)

A)

B) With the help of an example explain the architecture and how to decide on the required time steps needed in an RNN network. (4)

C) Hopfield network is a fully connected, single layer auto associative network. Illustrate with an example. (4)

5) Suppose you have a Hopfield network with 4 neurons, and you want to store two binary patterns in it. The patterns are as follows:

A) Pattern 1: [1, -1, 1, -1] Pattern 2: [1, 1, -1, -1]

Calculate the weight matrix for the Hopfield network based on these patterns (4)

Mention and elaborate steps in back propagation algorithm.

B) Consider a neural network with 3 input units, 2 hidden units and 1 output unit. The learning rate is 0.9. If the input pattern is (1, 0,1) and the hidden layer weights for the input are [[0.2, -0.3], [0.4,0.1], [-0.5,0.2]] respectively. The weights of output neuron from two hidden units are [-0.3, -0.2]. The bias for hidden node and output nodes are [-0.4,0.2,0.1] respectively. Calculate net input output, error at each (hidden and output) node and thus update weight and bias for 1 iteration. Use sigmoidal activation function. (4)

C) For a language model employing backpropagation through time on the input sequences 'BABY CRY CRY,' 'BABY SMILE SMILE,' and 'BABY CRY SMILE,' using one-hot encoded vectors, specify the total count of time steps involved in the training process and elaborate on the architecture utilized by the model for this training. (2)

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