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| **DIT UNIVERSITY DEHRADUN**   |  |  | | --- | --- | | **B.TECH (CSE)/MCA** | **ENDTERM EXAMINATION,ODD SEM 2024-25 (SEM V)** | | | | | | | | | | | | | |
| **Roll No.** |  |  |  |  |  |  |  |  |  |  |  |  |
| **Subject Name: Machine Learning** | | | | | | | | | | | | |

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| **Time: 3 Hours** | **Total Marks: 100** |
| **Note: No student is allowed to leave the examination hall before the completion of the exam.**  **Answers from a section must be written together and must not be mixed with answers from other section.**  **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**   |  |  |  |  | | --- | --- | --- | --- | | **SECTION 1: Attempt any five questions in SECTION 1:[5 x 8= 40]** | | | | |  | |  |  | | **Q.1.1)** | Suppose you have an ANN with 3 layers (1 input, 1 hidden, and 1 output) and the following configuration:  Input layer: 4 neurons  Hidden layer: 5 neurons  Output layer: 3 neurons  Calculate the total number of weights and biases required for this network. |  |  | | **Q.1.2)** | What are activation functions in neural networks, and why are they important? Give examples of common activation functions used in ANN. |  |  | | **Q.1.3)** | Explain the challenges faced by standard Recurrent Neural Networks (RNNs) due to the vanishing and exploding gradient problem. Discuss techniques that have been developed to mitigate these problems. |  |  | | **Q.1.4)** | Consider the following dataset of categorical values representing colors and shapes of objects:   | **Object** | **Color** | **Shape** | | --- | --- | --- | | A | Red | Circle | | B | Blue | Square | | C | Red | Square | | D | Green | Circle | | E | Blue | Circle | | F | Red | Square |   Suppose we want to cluster these objects into k=2 clusters using the k-modes clustering algorithm. The initial modes (centroids) are selected as:  Cluster 1: Mode = (Color: Red, Shape: Circle)  Cluster 2: Mode = (Color: Blue, Shape: Square)   1. Assign each object to the nearest cluster based on the number of mismatches with each cluster mode. 2. Update the modes for each cluster based on the new assignments. |  |  | | **Q.1.5)** | 1. Explain the key components of a decision tree in machine learning. 2. Describe how a decision tree is constructed and how it works. |  |  | | **Q.1.6)** | 1. Explain the concept of the kernel trick in Support Vector Machines (SVMs) and how it enables SVMs to handle non-linear data. 2. Discuss the types of kernel functions commonly used in SVMs and describe a scenario where using a non-linear kernel would be advantageous over a linear SVM. |  |  | | **SECTION 2: Attempt any four questions in SECTION 2:[4 x 15= 60]** | | | | |  | | **BTL** | **CO** | | **Q.2.1)** | Consider a CNN that takes a grayscale image of size 32×32 as input. The first convolutional layer has 8 filters, each with a kernel size of 3×3, a stride of 1, and no padding.   1. Calculate the output dimensions (height and width) after this convolutional layer. 2. If the layer is followed by a max-pooling layer with a 2×2 kernel and a stride of 2, what will be the output dimensions after the max-pooling layer? 3. Assuming the output of the max-pooling layer is flattened and passed to a fully connected layer with 64 neurons, determine the number of weights required for this layer. |  |  | | **Q.2.2)** | Consider a neural network with a single hidden layer. The input is 2, the weight from the input layer to the hidden layer is 0.5, and the weight from the hidden layer to the output layer is 0.8. Assume both neurons have a ReLU activation function, and the network output is calculated as:  =  =  =    Given a target output =3, use the Mean Squared Error (MSE) loss function:  Loss =   1. Calculate the forward pass and determine the loss. 2. Perform the backward pass to calculate the gradients of the loss with respect to and ​. |  |  | | **Q.2.3)** | (a) Explain the DBSCAN (Density-Based Spatial Clustering of Applications with Noise) clustering algorithm. How does DBSCAN determine clusters, and what are its main parameters? Discuss the advantages and limitations of DBSCAN compared to other clustering algorithms like k-means.  (b) Explain the concept of a Hidden Markov Model (HMM). Describe the key components of an HMM and explain the key steps of algorithm. |  |  | | **Q.2.4)** | 1. Given the following dataset with one feature (X) and one target variable (Y):  | **X** | **Y** | | --- | --- | | 1 | 2 | | 2 | 3 | | 3 | 5 |   You are tasked with finding the linear regression line Y=β0+β1X using the least squares method. Compute the slope β1 and intercept β0​. Write the linear regression equation. |  |  | | 1. Explain the key concept of Independent Component Analysis (ICA) and its difference from Principal Component Analysis (PCA). |  |  | | **Q.2.5)** | 1. Describe the basic structure and working of a perceptron in the context of neural networks. How does the perceptron learning rule work and adjust the weights. 2. Explain the structure and functionality of a Multilayer Perceptron (MLP). How does an MLP differ from a single-layer perceptron, and why is it more powerful for complex classification tasks? |  |  | | **-----END OF PAPER ----** | |  |  | | |