Enrolment No.:

MIT-ADT UNIVERSITY PUNE, INDIA

Total No. of Questions - 10]

[Total No. of Printed Pages - 2

**BTAISEM6 / B.TECH. (COMPUTER SCIENCE AND ENGINEERING-ARTIFICIAL INTELLIGENCE AND ANALYTICS)**
**21BTCS008 / MACHINE LEARNING**
**(2021 PATTERN)**

Date-24-05-2024

Time : 2:30 (09.30 am to 12.00 noon)

Maximum Marks : 60

*N.B. :-*
- (i) Neat diagram must be drawn wherever necessary.
- (ii) Figure to the right indicates full marks.
- (iii) Assume suitable data wherever necessary.
- (iv) Use of electronic pocket calculator is allowed (non-programmable).

**Q1. A)** Demonstrate the concept of "Learning a Class from Examples" in supervised learning [ 6 ] CO1 [ L3 ]

**B)** What is PAC learning, and why is it important in machine learning [ 6 ] CO1 [ L2 ]

*(OR)*

**Q2. A)** Discuss guidelines for conducting machine learning experiments. [ 6 ] CO1 [ L3 ]

**B)** Consider the example for classifying a car into 3 different classes Family car, Luxury sedan, Sports car. Design a machine learning experiment to handle multiclass classification. [ 6 ] CO2 [ L5 ]
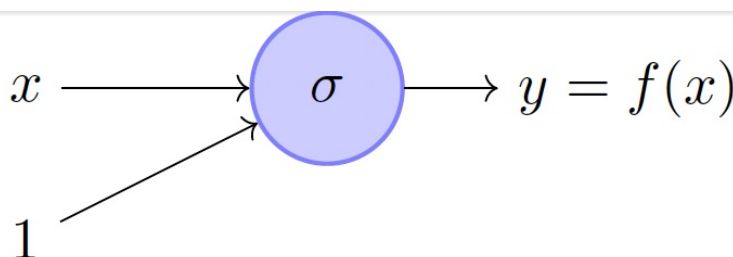
**Q3. A)** Discuss the steps involved in the backpropagation algorithm, including forward pass, backward pass, and weight updates with suitable example. [ 6 ] CO2 [ L4 ]

**B)** Discuss the concept of gradient descent and its role in optimizing the parameters of machine learning models. [ 6 ] CO2 [ L3 ]

*(OR)*

**Q4. A)** [ 6 ] CO2 [ L3 ]

$$x \longrightarrow \sigma \longrightarrow y = f(x)$$

$$1$$

$$f(x) = \frac{1}{1+e^{-(w \cdot x + b)}}$$

Prove that, $\nabla w = (f(x) - y) * f(x) * (1 - f(x)) * x$

**B)** Discuss and derive Support Vector Machine algorithm [ 6 ] CO2 [ L3 ]

**Q5. A)** Compare and contrast the bagging and boosting ensemble methods. [ 6 ] CO3 [ L4 ]

**B)** Apply KNN classification on the following dataset and predict the quality of paper_5 having Acid Durability = 3 and Strength = 7 for K= 3. The below table shows four training samples. [ 6 ] CO3 [ L3 ]

| Sample Paper | Acid Durability | Strength | Quality |
|---|---|---|---|
| Paper_1 | 7 | 7 | Bad |
| Paper_2 | 7 | 4 | Bad |
| Paper_3 | 3 | 4 | Good |
| Paper_4 | 1 | 4 | Good |

(Page 1 of 2)

**Q6. A)** Discuss and evaluate performance of KNN algorithm over other machine learning algorithms **[ 6 ] CO3 [ L3 ]**

**B)** Utilize the K-means algorithm to solve customer segmentation problem based on their income. Demonstrate various steps of K-means using suitable **[ 6 ] CO3 [ L3 ]** example

**Q7. A)** Discuss the steps in principal component analysis for dimensionality reduction. **[ 6 ] CO4 [ L3 ]**

**B)** Discuss Independent Component Analysis (ICA) and its goal in separating mixed signals into statistically independent components. **[ 6 ] CO4 [ L3 ]**

**Q8. A)** Prove that LDA minimizes the variance and maximizes the distance between the means of the two classes using suitable mathematical representations **[ 6 ] CO4 [ L5 ]**

**B)** Discuss the key steps involved in the LLE algorithm. How does LLE preserve the local structure of the data while reducing dimensionality **[ 6 ] CO4 [ L4 ]**

**Q9. A)** Discuss dropout, L1 regularization and L2 regularization with respect to overfitting in deep learning. **[ 6 ] CO5 [ L3 ]**

**B)** Propose real-world applications where deep learning techniques, such as convolutional neural networks or recurrent neural networks, can be effectively **[ 6 ] CO5 [ L5 ]** utilized for solving complex problems.

**Q10. A)** You are part of a research team developing an autonomous drone for wildlife monitoring in a national park. Propose and explain deep learning algorithm **[ 6 ] CO5 [ L5 ]** to detect and classify different species of animals.

**B)** You are working as a data scientist for a retail company, and the management wants to implement deep learning techniques to improve product **[ 6 ] CO5 [ L5 ]** recommendations for customers. Describe how deep learning algorithms such as neural networks can be applied to analyze customer purchase history and demographic data to generate personalized product recommendations.