7. (a) Compute the derivative of the mean squared error (MSE) cost function with respect to the model parameters θ_1 and θ_2 in linear regression, and how are the model parameters updated using the computed gradients? (10)

(b) Explain three common distance metrics used in clustering algorithms. (5)

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 739 **I**

Unique Paper Code : 6202453501

Name of the Paper : Machine Learning

Name of the Course : **B.Voc. (Software Development)**

Semester : V

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. The paper has **two** sections. **Section A** is compulsory. Each question is of **5** marks.
3. Attempt any **four** questions from **Section B**. Each question is of **15** marks.
4. Students are allowed to use a scientific calculator.

Section A

1. (a) Differentiate between supervised and unsupervised machine learning. (5)

(b) What is overfitting in machine learning, and what causes it? (5)

(c) How does a single-layer perceptron operate? Explain with a suitable diagram. (5)

(d) What are the different evaluation metrics used for regression? Explain any three of them, along with their advantages and disadvantages. (5)

(e) What is feature scaling? Describe the various types of feature scaling techniques used in machine learning. (5)

(f) Consider the following dataset and find the line of best fit using a least square regression method. Then, predict the value of Y for the test data point X=11. Show your calculations. (5)

X	Y
10	28
12	30
6	13
2	6

generated clusters and cluster centers after the first iteration. (Use Manhattan distance to compute the distance). (5)

A	B	C
1	2	2
2	4	1
2	3	1
6	3	8
5	2	9
1	4	3

(b) Explain the basic structure of a multi-layer perceptron. Explain how it can solve the XOR problem. (5)

(c) What is regularization? Explain the effect of λ (λ is a regularization parameter) on the model for the following values : (5)

(i) λ is set to zero

(ii) λ is a very large

(b) Differentiate between Standard and Stochastic Gradient Descent. (5)

5. (a) Given the input values X1 = 0.2, X2 = 0.5, X3 = 0.6, and X4 = 0.9, as shown in 5 Figure 1, calculate the output node value Y using a bias b=0.7 and the sigmoid activation function. (5)

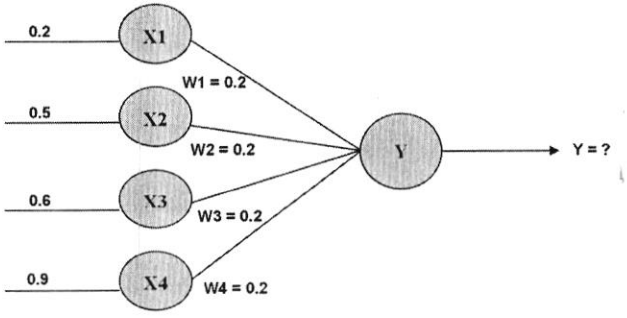

Fig. 1

(b) Write the truth table of the AND operation and solve it using a single-layer perceptron. (5)

(c) Discuss the classification of machine learning algorithms. (5)

6. (a) For the following data, apply one iteration of K-means clustering to partition the data into 2 clusters. Assume points C1 = (1,2,3) and C2 = (3,4,5) as the initial cluster centers. Show the

Section B

2. (a) Consider the confusion matrix given below and compute the following evaluation metrics by showing step-by-step calculations : (10)

(i) Accuracy

(ii) Precision

(iii) Recall

(iv) F1 score

		Actual Values	
		True	False
Predicted Value	True	75	5
	False	25	15

(b) If your model performs great on the training data but generalizes poorly to new instances, what is happening? Explain three possible solutions. (5)

3. (a) Using the K-nearest neighbors algorithm, predict the class for point A (X=4, Y=6) based on the given dataset. Assume k=3 and calculate the distances using the Euclidean distance formula. (5)

X	Y	Class
4	5	True
5	2	True
9	5	False
7	7	False
3	4	True

(b) Explain the K-means algorithm with a detailed step-by-step approach. (5)

(c) Describe the bias-variance trade-off in machine learning models and illustrate it with an appropriate diagram. (5)

4. (a) Construct a decision tree using the information gain formula for the given dataset. Provide a detailed, step-by-step calculation of the information gain at each stage and explain how the tree is built. (10)

Day	Outlook	Temperature	Humidity	Wind	Play
1	Sunny	Hot	High	Weak	No
2	Sunny	Hot	High	Strong	No
3	Overcast	Hot	High	Weak	Yes
4	Rain	Mild	High	Weak	Yes
5	Rain	Cool	Normal	Weak	Yes
6	Rain	Cool	Normal	Strong	No
7	Overcast	Cool	Normal	Strong	Yes
8	Sunny	Mild	High	Weak	No
9	Sunny	Cool	Normal	Weak	Yes
10	Rain	Mild	Normal	Weak	Yes
11	Sunny	Mild	Normal	Strong	Yes
12	Overcast	Mild	High	Strong	Yes
13	Overcast	Hot	Normal	Weak	Yes
14	Rain	Mild	High	Strong	No