UPES
End Semester Examination, December 2024

Course: Applied Machine Learning
Program: B. Tech Mechanical & Mechatronics
Course Code: MECH3059

Semester: V
Time   : 03 hrs.
Max. Marks: 100

Instructions: *All questions are compulsory. The question paper consists of 11 questions divided into 3 sections A, B and C. Section A comprises 5 questions of 4 marks each, Section B comprises 4 questions of 10 marks each and Section C comprises 2 questions of 20 marks each.*

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Compare ReLU and sigmoid activation functions.	4	CO1
Q 2	A layer 'L' in a neural network has 5 neurons and the previous layer has 4 neurons. How many model parameters are associated with layer L?	4	CO2
Q 3	Describe the matrix notation for getting activation from layer l (that is L) in a neural network.	4	CO1
Q 4	Explain vectorization in implementing machine learning algorithms and its advantage? Give an example	4	CO1
Q 5	Linear regression is not a good algorithm for classification. Discuss with an example	4	CO1

SECTION B
(4Qx10M= 40 Marks)

Q 6	Given two features, x1 (Range 1-5) and x2 (Range 10000-14000), what step will you take before applying gradient descent to ensure fast convergence.	10	CO2
Q 7	For given confusion matrix calculate (A)Precision (b)Recall (C)f1-score [[45,1], [11,33]],	10	CO2
Q 8	Describe the algorithmic steps of the K-Means Cluster method	10	CO1
Q 9	What is Information Gain and how is it used for deciding the feature for splitting in Decision tree?	10	CO2

SECTION-C
(2Qx20M=40 Marks)

Q 10	Consider the data for a linear regression problem given below. The raw data has x_1, x_2 and y. Manually do only 1 iteration of Gradient Descent for Linear regression on this data. In calculations, take initial guess as	20	CO3

$w_1 = 2, w_2 = 1, b = 1.$ Use learning rate $\alpha = 0.1$. After doing 1 iteration of Gradient Descent, also determine the equation for regression and the prediction for the following input $x_1 = 1, x_2 = 3$

All calculations must be shown clearly.

x_1	x_2	y
2	3	15
3	2	12
1	0	2
0	2	8

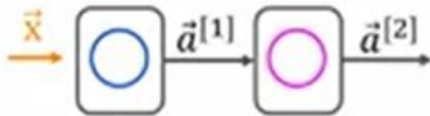**OR**

Implement K-Means algorithms for a given set of data using K = 2.

Individual	Variable 1	Variable 2
1	1	1
2	1.5	2
3	3	4
4	5	7
5	3.5	5
6	4.5	5
7	3.5	4.5

Q 11	Consider a hypothetical Neural Network with just two neurons with ReLU activation in layer 1 and Linear activation in layer 2. The cost function is defined by the mean square error as $$J = \frac{1}{2}\left(a^{[2]} - y\right)^2$$ Assuming $w^{[1]} = 3, b^{[1]} = 2, w^{[2]} = 2, b^{[2]} = 4$ and a single data point of x= 3 & y=4, show the forward propagation as well as back propagation steps through a computational graph and determine the value of updated model parameters $w^{[1]}, b^{[1]}, w^{[2]}, b^{[2]}$ after first iteration assuming learning rate $\alpha = 0.1$	20	CO3