National University of Computer and Emerging Sciences
Lahore Campus

Machine Learning
For Robotics (CS 4090)

Date: Sep 22 2025

Course Instructor(s)

Dr. Mirza Mubasher Baig

Sessional-I Exam

Total Time (Hrs):　　1
Total Marks:　　25
Total Questions:　　3

_____　　_____　　　　_____
Roll No　　　　　　　Section　　　　　　　　　Student Signature

Instructions: Answer in the space provided. Attach extra sheets if needed

CLO 1: Demonstrate basic understanding of widely used ML models & related learning algorithms.

Question 1: PART A [Nearest Neighbor Classification and Regression]

Classify the point (4, 3) using 3-nearest neighbors from the following data.

Point	X_1	X_2	Class	Distance used
A	1	2	Red	
B	2	3	Red	
C	3	3	Blue	
D	6	5	Blue	
E	7	7	Red	
F	8	6	Red	

i)　Clearly mark the three nearest neighbors used to assign a class to (4, 3). Just give distance values used without providing detailed distance calculations. [5 Points]

ii)　What will be the class assigned to a point (x, y) if 6 nearest neighbors are used instead of 3? [1 Point]

iii)　What would be the training accuracy of 6-neighbor classifier for this dataset?[1 Point]

Question 1: PART B [TREES]

Consider the following dataset with two features X_1 and X_2 and a real valued output Y.

Dataset			To learn a regression tree following procedure is used
X_1	X_2	Y	
7	15	3	Split using one feature at a time, and the split point is always the
3	13	2	median point of that feature's range so that the data is always divide
2	14	4	into two equal parts (almost). The feature that has the minimum MSE
4	12	5	after the split is selected. Te MSE after split is sum of MSE of the two
5	11	6	partitions of data.
6	18	7	
1	91	9	
8	17	10	

Using this approach learn a single node regression tree for the dataset given above. [6 Points]

To get full marks you must provide threshold for each feature, the value assigned to each split and the MSE for each split

Question 1: PART C [Linear MODELS]
i) Which one of the following models are linear. **[2 Points]**

a) Support Vector Machines	b) Perceptrons	c) KNN	d) Logistic Regression

ii)	Use a single iteration of gradient descent to fit a logistic regression model to predict the class of an object based on a single numeric feature X using the following dataset.	Dataset	
		X	Y
		1	0
		0	1
	Use w = 0 and b = 0 as initial values of the parameters and use η = 0.1 as learning rate and use cross-entropy loss as the loss function. **[6 Points]**		

Gradient of the cross entropy loss is computed as follows

$$\frac{\partial L}{\partial w} = \frac{1}{n}\sum_i (\hat{y}_i - y_i)x_i$$

$$\frac{\partial L}{\partial b} = \frac{1}{n}\sum_i (\hat{y}_i - y_i)$$

iii)   Also compute the value of cross entropy loss before and after the update. Show your calculations **[3 Points]**

iv)   Give an example dataset consisting of four points that is not linearly separable **[1 Points]**