2/5/2025

ECS - TE Sem VI Reg C ischeme Summer 2025

Duration: 3hrs **Max Marks:80**

N.B.: (1) Question No 1 is Compulsory.
(2) Attempt any three questions out of the remaining five.
(3) All questions carry equal marks.
(4) Assume suitable data, if required, and state it clearly.

1 Attempt any FOUR [20]

a Compare a biological neuron with an artificial neuron in a neural network.

b Explain Hebbian Learning rule for classification

c Explain the Singular Value Decomposition (SVD) of a real matrix M. List two practical applications of SVD in data analysis

d Explain different activation function used in Neural Network with formulas.

e Describe any three three feature selection methods

2 a Derive the equations for fitting a simple linear regression model $y=\beta_0+\beta_1 x$ using the least squares method. Show all steps leading to the expressions for β_0 and β_1 [10]

b Assume you have a dataset of 8 pulse-rate observations coming from a mixture of two Gaussian components ("Medium Pulse" and "Large Pulse"): [10]

Component	Data Points			
A	12	16	13	14
B	65	70	75	80

Apply EM Algorithm for one iteration with initial guesses are as below.
Mean (A)=10, Mean (B)=75
Variance of A and B=25
P(A)=P(B)=0.5

3 a How does regularized regression differ from simple linear regression? Discuss the significance of using regularization in regression models, and explain one common regularization technique. [10]

b Define the following terms [10]
I) Norm of a vector. II) Inner product (dot product) of two vectors.
II) Length of a vector. IV) Distance between two vectors. V)what it means for two vectors to be orthogonal.
For given two vectors calculate norm, inner product, length, distance and check whether vectors are orthogonal or not?
v=(1,−2,3,0,4,−1),w=(2,1,−1,3,0,2).

4 a Explain Error Back Propagation Algorithm. [10]

b Apply PCA on following given 2D data to find transformed data. Calculate Eigen values. Find largest Eigen Vector. Given (Mean of x is 8 and mean of y is 8.5) [10]

x	4	8	13	7
y	11	4	5	14

5 a Define Precision, Recall, F1 Score, Accuracy. Total 16 docs are there in the database. For a query, 8 are relevant and 8 are non relevant. Total 10 documents are retrieved from ML application as below. Calculate Precision, Recall, F1 score and draw confusion matrix (R-Relevant, IR -Irrelevant) [10]

Doc	1	2	3	4	5	6	7	8	9	10
R/IR	R	R	IR	R	IR	IR	IR	IR	IR	R

b Explain the Delta Learning Rule algorithm and demonstrate its application for one training epoch on a simple logic gate of your choice (e.g., AND, OR, or NAND). [10]

6 a Explain Classification, Prediction and Clustering in detail. [10]

b a) Design a McCulloch–Pitts neuron (specify weights and threshold) to implement each of the following logic gates: AND, OR, NOT [10]
b) Explain why a single McCulloch–Pitts neuron cannot realize the XOR function.

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