



SPRING END SEMESTER EXAMINATION-2023

6th Semester B.Tech

MACHINE LEARNING

CS 3035

(For 2021 (L.E), 2020 & Previous Admitted Batches)

Time: 3 Hours

Full Marks: 50

Answer any SIX questions.

Question paper consists of four SECTIONS i.e. A, B, C and D.

Section A is compulsory.

Attempt minimum one question each from Sections B, C, D.

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable and all parts of a question should be answered at one place only.

SECTION-A

1. Answer the following questions. [1 × 10]
- (a) What is the difference between binary and multiclass logistic regression?
 - (b) What is the naive Bayes algorithm, and what are its assumptions and limitations?
 - (c) What is principal component analysis (PCA), and how is it used for dimensionality reduction in machine learning?
 - (d) Explain the difference between L1 and L2 regularization in linear regression, and when should each be used?
 - (e) What is the difference between precision and recall in binary classification, and how are they related to the F1 score?
 - (f) Which of the following is not an evaluation metric for regression problems?
 - a) Mean Absolute Error (MAE) b) Root Mean Squared Error (RMSE)
 - c) R-Squared (R²) d) F1-Score
 - (g) What is the difference between batch gradient descent and stochastic gradient descent in machine learning?
 - (h) What is overfitting in machine learning, and how can it be prevented?

- (i) Which of the following is a classification algorithm in machine learning?
- a) Linear Regression b) K-Nearest Neighbors
c) Orthogonal Matching Pursuit d) Random Forest
- (j) What is the purpose of feature scaling in machine learning?
- a) To standardize the range of input features.
b) To make the model more complex.
c) To increase the training time.
d) To decrease the accuracy of the model.

SECTION-B

2. (a) Compare the difference between Logistic Regression and Linear Regression. [4]
(b) Analyze the short comings of ID3 Decision Tree [4]
3. (a) Compare the vanishing gradient and exploding gradient are two common issues that can occur during back propagation in artificial neural networks (ANN). [4]
(b) Compare the difference between parametric and non-parametric machine learning. Explain the following with examples: One-Against-All (OAA) and One-Against-One (OAO). [4]

SECTION-C

4. (a) Derive the Logistic Regression cost function from scratch and explain each notations used in every steps. [4]
(b) Suppose you have a dataset of animals and you want to use KNN to predict whether a new animal is a cat or a dog based on its weight and height. You have the following dataset: [4]

Animal	Weight (kg)	Height (cm)	Species
1	4	35	Cat
2	6	40	Dog
3	3	25	Cat
4	7	45	Dog
5	5	30	Cat
6	8	50	Dog
7	2	20	Cat
8	5	35	Dog

Predict the species of a new animal that weighs 4 kg and is 30 cm tall.

5. (a) Examine any two distance measures (with mathematical expressions) that they follow the properties of distance metric. [4]

- (b) Cluster the given dataset of e-commerce sales with the following features: [4]

Product_ID: ID of the product sold

Price: Price of the product (in dollars)

Quantity: Quantity of the product sold

Category: Category of the product (A, B, or C)

We want to use K-means clustering to group the products into three clusters based on their price and quantity. We will use $K=3$ for the K-means algorithm.

The sales data:

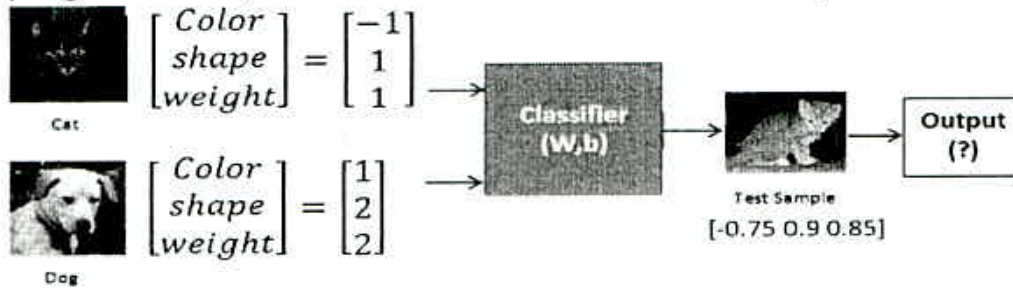
Product_ID	Price	Quantity	Category
1	50	10	A
2	40	8	A
3	60	12	A
4	70	15	B
5	80	18	B
6	90	20	C
7	100	22	C
8	110	25	C

6. (a) State at least five types of activation functions. [4]

Differentiate between linearly and non-linearly separable datasets. A two input single output neuron model has weights value $[-1.5 \ 2.0]$ and bias of -2.5 . It is given an input $[2.23.1]$. What will be the output if the binary step function threshold=1 is used?

- (b) Solve the problem: Use a Three-Input/Single-Neuron Perceptron with weights $w_{11}=1$, $w_{12}=0.5$ and $w_{13}=1$. Draw the perceptron, decision boundary and compute whether [4]

test sample $[-0.75 \ 0.9 \ 0.85]$ is cat (target class 0) or dog (target class 1). Use transfer function hardlim().



SECTION-D

7. (a) Analyze the slack variable and its role in soft-margin SVM classifier with suitable diagram. States the Mercers conditions for a valid kernel function. [4]
- (b) Solve the following dataset stepwise and predict whether a “Red Domestic SUV” is “Stolen” or not using Decision Tree. [4]

Example No.	Color	Type	Origin	Stolen?
1	Red	Sports	Domestic	Yes
2	Red	Sports	Domestic	No
3	Red	Sports	Domestic	Yes
4	Yellow	Sports	Domestic	No
5	Yellow	Sports	Imported	Yes
6	Yellow	SUV	Imported	No
7	Yellow	SUV	Imported	Yes
8	Yellow	SUV	Domestic	No
9	Red	SUV	Imported	No
10	Red	Sports	Imported	Yes

8. (a) Create the reduced dimension of the given data from 4 to 2 using Principal Component Analysis (PCA). [4]

Sampales	A	B	C	D
1	14	18	13	7
2	40	4	5	14
3	87	11	13	23
4	8	15	8	45

- (b) Design a three inputs, two layers with two-two neurons and one output ANN model with its input to output relationship using F() as an activation function. [4]
