

[This question paper contains 6 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 1262

A

Unique Paper Code : 32347607

Name of the Paper : Machine Learning

Name of the Course : B.Sc. (Hons.) Computer Science
(LOCF)

(Admission of 2019)

Semester : VI

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Section A is compulsory.
3. Attempt any 4 (four) questions from Section B.
4. Use of scientific calculator is allowed.

SECTION A

1. (i) Distinguish between supervised learning and unsupervised learning. Illustrate with an example. (5)
(ii) Define Concept Learning. How the concept learning can be viewed as the task of searching? (5)

- (iii) Calculate the output y of a single layer neural network with three input neuron and one output neuron. The input feature vector is $(x_1, x_2, x_3) = (0.8, 0.6, 0.4)$ and weight values are $[w_1, w_2, w_3] = [0.2, 0.1, -0.3]$ and bias = 0.35. Use binary Sigmoid function as activation function. (5)
- (iv) Distinguish between overfitting and underfitting. How it can affect model generalization? (5)
- (v) Using an example discuss how new features can be constructed by forming Cartesian production of existing features. What are the implications of this approach? (5)
- (vi) Suppose that the probability of five events are $P(\text{first}) = 0.5$ and $P(\text{second}) = P(\text{third}) = P(\text{fourth}) = P(\text{Fifth}) = 0.125$. Calculate its entropy. (5)
- (vii) Use K-means clustering to cluster the following data into two groups :

$$\{2, 4, 10, 12, 3, 20, 30, 11, 25\}$$

Assume cluster centroid are $m_1=2$ and $m_2=4$. The distance function used is Euclidean distance. (5)

SECTION B

2. (i) Find the least square regression line for the given dataset using the normal equation method. Show computation at each step.

x1	x2	y
1	9	14
2	1	7
3	2	12
4	3	16
5	4	20

(4)

- (ii) Consider the dataset given below having two input variables x_1 , x_2 and one output variable y . Update the coefficients θ_0 , θ_1 and θ_2 using gradient descent for the logistic regression model. Assume the learning rate = 0.3 and the initial values of coefficients as $\theta_0 = -0.5$, $\theta_1 = 1$, and $\theta_2 = -1$. Perform one iteration of gradient descent. (6)

x1	1	3	8	6
x2	2	5	3	2
y	0	0	1	1

3. (i) State Bayes Theorem. (2)
- (ii) Consider the training data in the following table where Play is a class attribute.

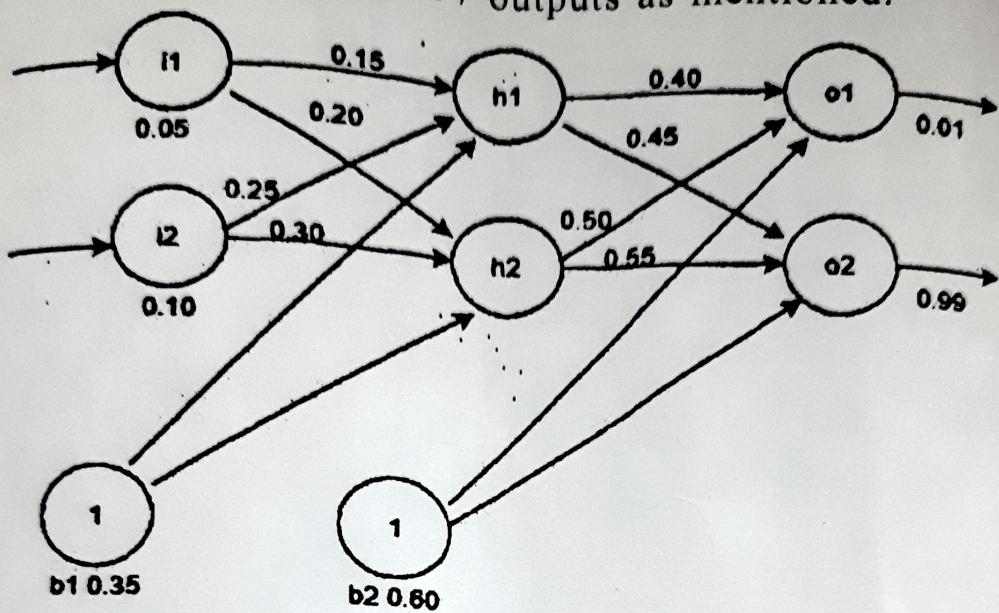
Humidity	Sunny	Wind	Play
L	N	S	N
H	N	W	Y
H	N	W	N
H	Y	S	Y
H	N	W	Y
L	Y	S	N

Build a Naive Bayes Classifier using the above data.
 Estimate the class label for day (Humidity=L, Sunny=N,
 Wind=W) using the above classifier. (8)

4. (i) Differentiate between Standard and Stochastic Gradient Descent. (4)
- (ii) Identify the first splitting attribute for decision tree with the following dataset using ID3 algorithm :

Field	Experience	Hired
IT	Coding	No
IT	Coding	No
IT	Administration	Yes
IT	Administration	Yes
Business	Coding	Yes
Business	Coding	Yes
Business	Administration	No
Business	Administration	No

5. Consider the following neural network with initial weights, biases, and training input / outputs as mentioned.



Given the inputs $i_1 = 0.05$, $i_2 = 0.10$, determine the values of output nodes o_1 and o_2 . Also calculate the prediction error E_{total} if the actual output values o_1 and o_2 are 0.01 and 0.99 respectively. Use Sigmoid as the activation function for the hidden as well as the output layers. (10)

- (i) What is the difference between K-means clustering and K-Nearest Neighbor classifier? (4)
- (ii) Discuss steps used by Principal Component Analysis to extract important features. (6)

- (i) Given the set of values $X = (3, 9, 11, 5, 2)^T$ and $Y = (1, 8, 11, 4, 3)^T$. Evaluate the regression coefficients using ordinary least square method. (4)

- (ii) Assume a total of 1,000 patients are tested for influenza; 900 are found to be healthy, while 100 are found to be sick. A test resulted in 60 being positive and 40 being negative for the sick persons. The same test was positive for 120 and negative for 780 in healthy adults. Construct a confusion matrix for the data and determine precision and recall. (6)
8. (i) What is regularization? What is the effect of the following on the model?
- (a) The regularization parameter (λ) is zero
(b) The regularization parameter (λ) is very large (4)
- (ii) State the mathematical formulation of the SVM problem. Give an outline of the method used for solving the classification problem using SVM. (6)