

Nirma University

Institute of Technology

Semester End Examination (IR), December - 2022
B. Tech. in Computer Science and Engineering, Semester-V
2CS501 Machine Learning

Roll /
Exam
No.

Supervisor's
initial with
date

Time: 3 Hours

Max. Marks: 100

Instructions:

1. Attempt all questions. Use section-wise separate answer book.
2. Figures to right indicate full marks.
3. Draw neat sketches wherever necessary.
4. Assume suitable data wherever applicable and clearly mention them.
5. CLO_ and BL_ have been mentioned against each question to map it as per Course Learning Objective and Bloom's taxonomy.

SECTION I

- Q 1 A Use competitive learning neural network to cluster 6, three- [10]
CLO2 dimensional data points (1.1 1.7 1.8), (0 0 0), (0 0.5 1.5), (1 0
BL3 0), (0.5 0.5 0.5), (1 1 1) into 3 clusters. Assume initial cluster
centroids to be (0.2 0.7 0.4), (0.1 0.2 0.9), (1 1 1.1) and
learning rate to be 0.25. Report cluster centroids after 1
round/epoch of execution.

OR

- Q 1 A Both k-means and hierarchical clustering algorithms can [10]
CLO2 perform effective clustering. Illustrate the strength and
BL3 weakness of these algorithms. Write algorithms for k-means
and hierarchical agglomerative clustering.
- Q 1 B Discuss self-training algorithm for learning from labelled and [8]
CLO2 unlabelled data. Also discuss 2-step approach for learning
BL2 from positive and unlabelled data. How are these algorithms
used at training and inference time?

- Q 2 A What is reinforcement learning? Which are different [6]
CLO2 implementation approaches for reinforcement learning
BL2 algorithms? Discuss Q-learning algorithm in detail.

- Q 2 B Assume a 3-2-1 feed-forward fully connected neural network [12]
CLO3 (3 neurons in the input layer denoted as neuron 1, 2 and 3,
BL3 2 neurons in the hidden layer denoted as neuron 4 and 5, and
1 neuron in the output layer denoted as neuron 6). Assume
that the activation function of all the neurons in the hidden
and output layers is log-sigmoid. Neurons in the hidden layer
and output layer also have bias connection. Consider
following table for the initial value of parameters.

W14	W24	W34	W15	W25	W35	W46	W56	b4	b5	b6
0.2	0.5	0.3	0.3	0.1	0.4	0.5	0.6	0.1	0.2	0.3

W14 is the weight of the connection between neuron 1 and 4.
b4 is the weight of the bias connection of neuron 4. Other
notations can be understood in the same way. Assume

learning rate to be 0.5 and one half squared error as the loss function. Assume the input→output pair (training example) to be (5,3,6)→(1). Present this example and backpropagate error to calculate updated value of the weight W14.

Q 3 A What is margin and separating hyperplanes in support vector machine? Write objective function and constraints of soft-margin support vector classifier (SVC). How can SVC be used at inference time? [8]
CLO1
BL2

Q 3 B Explain different measures for evaluating a classifier. [6]
CLO2
BL2

SECTION II

Q 4 A How can you handle (i) a categorical attribute and (ii) numerical attribute in ID3 and CART? Discuss in detail with suitable examples. [6]
CLO1
BL2

OR

Q 4 A A property owner is faced with a choice of: [6]
CLO1
BL2

(i) A large-scale investment (A) to improve her flats. This could produce a substantial pay-off in terms of increased revenue net of costs but will require an investment of £1,400,000. After extensive market research it is considered that there is a 40% chance that a pay-off of £2,500,000 will be obtained, but there is a 60% chance that it will be only £800,000.

(ii) A smaller scale project (B) to re-decorate her premises. At £500,000 this is less costly but will produce a lower pay-off. Research data suggests a 30% chance of a gain of £1,000,000 but a 70% chance of it being only £500,000.

(iii) Continuing the present operation without change (C). It will cost nothing, but neither will it produce any pay-off. Clients will be unhappy and it will become harder and harder to rent the flats out when they become free.

How will a decision tree help the taking of the decision? Assume training set shown in the following table.

Q 4 B [12]
CLO3
BL3

Temperature	Humidity	Play
85	85	No
65	70	No
72	95	No
83	78	Yes
70	96	Yes
64	65	Yes
72	90	Yes

Assume "Play" as the class label. Using (i) 3-NN and (ii) similarity-weighted 3-NN predict whether play will be possible given the Temperature = 83 and Humidity = 64. Consider cosine similarity as the similarity measure.

- Q 5 A Propose methods for addressing the class imbalance problem. [8]
 CLO2 Suppose a bank wants to develop a classifier that guard
 BL6 against fraudulent credit card transactions. Illustrate how
 you can induce a quality classifier based on a large set of
 nonfraudulent examples and a very small set of fraudulent
 cases

OR

- Q 5 A How can a binary classifier be used for multiclass (more than [8]
 CLO2 2 classes) classification? Discuss at least 2 methods for the
 BL6 same.
 Q 5 B Discuss steps for classification using linear discriminant [6]
 CLO1 analysis.
 BL2

- Q 6 A The following table shows the midterm and final exam grades [12]
 CLO3 obtained for students in a database course.
 BL3

Midterm Exam (x)	Final Exam (y)
72	84
50	63
81	77
74	78
94	90
86	75
59	50
83	79
65	77
33	51
88	74
81	91

- (i) Plot the data. Do x and y seem to have a linear relationship?
 (ii) Find a linear regression equation for the prediction of a
 student's final exam grade based on the student's midterm
 grade in the course.
 (iii) Predict the final exam grade of a student who received an
 86 on the midterm exam.
- Q 6 B What is regularization? When should you use it in multiple [6]
 CLO1 linear regression? How is it used in multiple linear
 BL2 regression? Write equations for updating parameters of
 multiple linear regression considering regularization.