Nirma University

Institute of Technology

Semester End Examination (IR/RPR), April - 2025
B. Tech. in Computer Science and Engineering, Semester-V
B. Tech. in CH / ME / EE / EC / EI, Semester-VI
Bachelor of Commerce (Hons.), Semester-VI
3CS101CC24 Machine Learning

Roll / Exam No. _____ Supervisor's initial with date _____

Time: 3 Hours Max. Marks: 100

Instructions:
1. Attempt all questions.
2. Figures to the right indicate full marks.
3. Assume suitable assumptions and specify them.
4. Section-wise separate answer book to be used.

Section – I

Q-1. Answer the following. **[16]**

A. CO3,BL4 Discuss simple competitive learning neural networks and self-organizing maps in detail. Compare and contrast self organizing maps with ANN. [08]

B. CO2,BL6 Discuss the semi-supervised learning in detail. Discuss in detail about Learning from labeled and unlabeled Data in the context of semi-supervised learning. [08]

Q-2. Do as directed. **[18]**

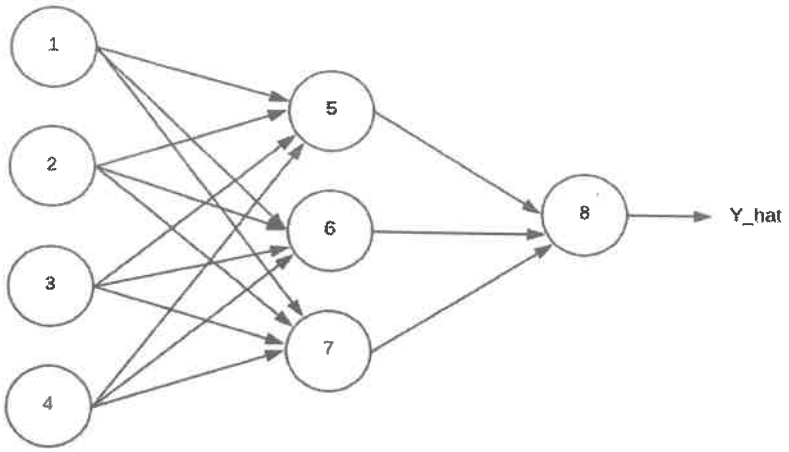
A CO4,BL3 Imagine a cybersecurity system analyzing a dataset of 920 network activities. Among these, 600 activities are deemed safe, while 320 activities are flagged as potentially malicious. Out of the flagged activities, 180 are correctly identified as malicious, while 140 are incorrectly labeled as safe. Moreover, 480 safe activities are correctly identified, while 120 are mistakenly classified as potentially malicious. Construct a confusion matrix for the given data and compute precision, recall, and F-measure. Clearly outline the formulas used for each metric and present your step-by-step calculations. [07]

B CO1,BL3 Consider the following positive data points {(4,1), (4,-1), (6,0)} and negative data points {(1,0), (0,1), (0,-1), (-1,0)}. Use linear SVM function to find hyperplane equation. [07]

C CO2,BL1 Discuss the need of normalization. Explain min-max normalization with suitable example. [04]

Q-3. CO3,BL4 For the following neural network to be used for a binary classification task, the terminologies are as follows: **[16]**

- Xi -> the value of i^{th} input feature
- Wij -> the weight associated with the connection from neuron i to neuron j in the next layer
- Θ_i -> bias of the i^{th} neuron
- Y -> actual output for a given input example
- Y_hat -> prediction from the network for the input example



Parameter	W_{15}	W_{25}	W_{35}	W_{45}	W_{16}	W_{26}	W_{36}	W_{46}
Value	-0.6	0.8	0.2	0.3	0.1	0.4	0.5	-0.7
Parameter	W_{17}	W_{27}	W_{37}	W_{47}	W_{58}	W_{68}	W_{78}	Y
Value	0.2	-0.4	0.8	0.9	0.3	0.6	-0.3	1
Parameter	X_1	X_2	X_3	X_4	Θ_5	Θ_6	Θ_7	Θ_8
Value	0	1	-1	0	0.4	-0.6	0.3	0.8

The above table lists all the values, answer the following questions:

1. Execute one forward pass, show all steps and compute the predicted output. Consider sigmoid activation function for all the neurons.
2. Execute one backward pass based on the above predicted value, and obtain updated value of weights and biases. Assume learning rate = 0.5.

Section – II

Q.4. CO3,BL4 Using the Decision Tree classifier algorithm and the following training data, find the class label for a test record X. X={Fever=Yes, Cough=No, Breathing issues=YES, Infected=?}. Build the entire Decision tree by using Information Gain. Show all the steps. **[18]**

Fever	Cough	Breathing issues	Infected
NO	NO	NO	NO
YES	YES	YES	YES
YES	YES	NO	NO
YES	NO	YES	YES
YES	YES	YES	YES
NO	YES	NO	NO
YES	NO	YES	YES
YES	NO	YES	YES
NO	YES	YES	YES
YES	YES	NO	NO
NO	YES	NO	NO
NO	YES	YES	YES
NO	YES	YES	YES
YES	YES	NO	NO

Q-5. CO3,BL4 Consider the following 2-D data A(2,6) B(3,4) C(3,8) D(4,7) E(6,2) F(6,4). Use the k-means algorithm on given two-dimensional dataset to construct two clusters. Execute the algorithm for two iterations using Euclidean distance and consider A and C as initial seeds. **[12]**

Q.6. Do as directed. **[20]**

A. CO3,BL4 Apply Gaussian naive Bayes classifier on following dataset to predict the class label for a new observation (5.4, 3.1). [10]

Observation	Feature 1	Feature 2	Class Label (C)
1	5.1	3.5	A
2	4.9	3.0	A
3	6.2	2.8	B
4	5.6	3.0	A
5	5.9	3.2	B
6	5.0	3.1	A
7	6.0	2.9	B
8	5.5	3.5	A
9	6.3	3.1	B
10	5.2	3.0	A

B. CO3,BL4 Consider the following initial set-up for Q-Learning. Answer the following questions considering the Gamma=0.8. [10]

1. Create Q and R Matrix.
2. Consider that you are at state 1 and you want to reach to state 5 (Action). Modify the Q and R matrix after the Q(1,5) (Episode-1).
3. Consider that you are at state 3 and you want to reach to state 1 (Action). Modify the Q and R matrix after the Q(3,1) (Episode-2).