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Daffodil International University

Faculty of Science & Information Technology
Department of Computer Science & Engineering
Final Semester Examination, Spring 2025
Course Code: CSE325, Course Title: Data Mining and Machine Learning
Level: 3 Term: 2 Batch: 62

Time: 2:00 Hrs **Marks: 40**

Answer ALL Questions

[The figures in the right margin indicate the full marks and corresponding course outcomes. All portions of each question must be answered sequentially.]

1. The following dataset contains shopping transactions from an online fashion store. Your task is to apply the FP-Growth algorithm to extract all frequent itemsets that satisfy a minimum support threshold of 50%. — CO1

Transaction ID	Items Purchased
T1	T-Shirt, Sneakers, Jeans, Cap, Sunglasses
T2	Jacket, Sneakers, T-Shirt, Jeans
T3	Sunglasses, Watch, Sneakers, Jeans
T4	T-Shirt, Sneakers, Belt, Cap
T5	Jeans, Jacket, Watch, Sneakers, T-Shirt
T6	T-Shirt, Sneakers, Watch, Sunglasses
T7	Cap, Sneakers, Jeans, T-Shirt, Jacket

a)	Construct the FP-Tree based on item frequency and item ordering.	[5]
b)	Explain how conditional pattern bases and conditional FP-Trees are formed.	[3]
c)	Discuss the efficiency of FP-Growth over Apriori, especially for dense datasets.	[2]

2. You are given a set of 15 two-dimensional points representing spatial coordinates of tracked devices in a smart campus. Apply the DBSCAN algorithm using the following parameters: minPts = 4, eps (ε) = 2.0. — CO1

$P_1(1,6)$, $P_2(2,5)$, $P_3(3,7)$, $P_4(4,6)$, $P_5(5,5)$, $P_6(5,3)$, $P_7(4,2)$, $P_8(6,2)$, $P_9(2,2)$, $P_{10}(1,3)$, $P_{11}(3,3)$, $P_{12}(6,5)$, $P_{13}(7,4)$, $P_{14}(8,5)$, $P_{15}(7,6)$

a)	Identify all core points and border points based on the parameters provided.	[2.5]
b)	Use the DBSCAN algorithm to form clusters – i) List all clusters and ii) Indicate which points are noise (if any)	[2.5]

3. You are given the following dataset consisting of 10 samples with 3 features: — CO1

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Sample	Feature A	Feature B	Feature C
A	2	0	1
B	0	1	4
C	4	3	2
D	3	5	3
E	1	2	2
F	5	1	0
G	2	4	1
H	3	2	4
I	1	0	3
J	0	3	2

	a)	Standardize the dataset so that each feature has zero mean and unit variance.	[2.5]
	b)	Compute the covariance matrix of the standardized dataset.	[2.5]
	c)	Find the eigenvalues and eigenvectors of the covariance matrix.	[2.5]
	d)	Identify the principal components in descending order of variance explained.	[2.5]

4. An artificial neural network has been trained on a binary classification dataset where the independent attributes are Feature A and Feature B. The target classes are encoded as Class A = 0 and Class B = 1 before training. CO2

In this network: (i) All hidden nodes use the ReLU activation function, and (ii) The output node uses the Sigmoid activation function

The trained network is shown below. Classify the data samples in Table 1 using this network.

Table 1: Test Data

Sample	Feature A	Feature B
S1	1.2	2.5
S2	2.0	1.0

Neural Network Architecture

- Input Layer: Feature A, Feature B, and Bias
- Hidden Layer: 3 neurons (H1, H2, H3)
- Output Layer: 1 neuron (O)

Input to Hidden Weights:

From → To	H1	H2	H3
Feature A	-1.5	1.0	2.1
Feature B	2.3	-0.7	1.8
Bias	-1.0	-1.2	-0.5

Hidden to Output Weights:

From → To	Output
H1	2.0
H2	-1.5
H3	1.3
Bias	-2.0

	a)	Compute the input to each hidden neuron using the given weights and bias.	[2.5]
	b)	Apply the ReLU activation to hidden neurons.	[2.5]
	c)	Compute the input to the output neuron and apply the Sigmoid activation.	[5]
	d)	Classify the result as Class A (0) or Class B (1) based on threshold 0.5.	[5]