

National Institute of Technology, Delhi

Name of the Examination: M.Tech/Ph.D

Mid Semester Examination (Spring, 2023)

Branch : Computer Science and Engineering (Analytics) Semester : 1

Title of the Course : Soft Computing Course Code : CSLM 625

Time: 90 Minutes

Maximum Marks : 25

Answer the following questions.

Q.No.	Questions	Marks	CO	BL
1)	Find the stationary point of the function $f(x_1, x_2) = 1 - x_1^2 - x_2^2$ subject to constraint $g(x_1, x_2) = x_1 + x_2 - 1 = 0$.	2.5	1	III
2)	Write pseudocode for a numerical estimation of the value of pi using Monte Carlo Method.	4	1	IV
3)	What is the difference between overfitting and underfitting by a model?	2	2	II
4)	For each of the following boolean operators, indicate whether it is linearly or non-linearly separable: AND, OR and XOR.	1.5	2	II
5)	Prove mathematically that the decision boundary of a support vector machine is determined only by the points closest to the decision boundary (support vectors).	7	2	IV
6)	State the similarities and differences between perceptron and adaline?	2	2	IV
7)	For each of the following models, indicate whether it is linear or non-linear: Support Vector Machine, Neural Network, Perceptron, adaline.	2	2	II
8)	What is a radial basis function network and how many hidden layers are used in it?	2	2	II
9)	Two dice are rolled, if it is known that at least one of the dice always shows 4, find the probability that the numbers appeared on the dice have a sum 8.	2	1	III



राष्ट्रीय प्रौद्योगिकी संस्थान दिल्ली

NATIONAL INSTITUTE OF TECHNOLOGY DELHI

(शिक्षा मंत्रालय, भारत सरकार के अधीन एक स्वायत्त संस्थान)

(An autonomous Institute under the aegis of Ministry of Education (Shiksha Mantralaya), Govt. of India)

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Autumn Semester AY 2023-24

Department of Computer Science and Engineering

Mid Semester Examination

October 13, 2023 (02:30 – 04:00 PM)

Degree	M. Tech.	Branch	CSE
Semester	I		
Subject Code & Name	CSLM 624 – Social Network Analysis		
Time: 90 Minutes	Answer All Questions		Maximum: 25 Marks

Q. No.	Questions	Marks	BL	CO
1.a	Explain the key market drivers that have motivated the integration of Network Analysis with Social Sciences for Social Network Analysis.	2	L2	CO1
1.b	Suppose, a crowd-sourced data sensing-based system is being used for analyzing vehicles' mobility. Analyze the statement "Social Interaction between vehicles can help in managing smoothened driving experience"	3	L4	CO2
2.a	What is <i>Closeness Centrality</i> and <i>Betweenness Centrality</i> ? How does they contribute in a Social Network Analysis?	2 (1+1)	L2	CO2
2.b	Identify, Demonstrate and analyze any three vital <i>Network Measures</i> that could lead to the suggestions of profiles/pages on social media.	3 (1+1+1)	L4	CO2
3.a	Differentiate between <i>Link-centric View</i> and <i>Node-centric View</i> in terms of Network Analysis. Discussion with illustration is required.	2 (1+1)	L2	CO1
3.b	Let's suppose, there is a requirement for the analysis of social behavior of entities in different areas/domains for various applications. Apply your understanding of network types to discuss each of the following network for an application scenario: i. Bipartite Network ii. Heterogenous Network iii. Attributed Network	3 (1+1+1)	L3	CO1
4.a	Explain, why is <i>Adjacency Lists</i> considered appropriate data structure for maintaining Social Network information?	2	L2	CO1
4.b	Evaluate a situation using a <i>Network Measure</i> to trace persons which are being influenced from a common ideology on Social Media platforms.	3	L5	CO2

5.a	Apply the concept of <i>Social Network Analysis</i> , to build a conceptual framework that could be helpful in containing infection during the pandemic of COVID-19. A proper rationality in opting each component of the framework is required.	5	L5	CO1
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*****Good Luck*****

National Institute of Technology, Delhi

Name of the Examination: M. Tech & PhD

Branch : CSE

Semester : I

Title of the Course : Machine Learning

Course Code : CSΔM (611)

Time: 1.5 Hours

Maximum Marks: 25

Note : Please attempt all questions

Q. No	Questions	Marks	CO	BL	PO	PI Code																				
1a	Explain K-nearest neighbor algorithm for a discrete valued function.	2	CO1	L1	1																					
1b	Explain locally weighted linear regression.	2	CO1	L1	1																					
2	<p>Learn the equation for regression line from a set of 10 training data points given below using liner regression. Use the equation of the regression line to predict the value of output/dependant variable(Y) when the value of input/independent variable(x) is 3.5.</p> <table><tr><td>X: (independent variable)</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>5</td><td>6</td><td>6</td><td>7</td></tr><tr><td>Y: (Dependent variable)</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>	X: (independent variable)	1	2	3	4	5	5	6	6	7	Y: (Dependent variable)										5	CO1	L1	1	
X: (independent variable)	1	2	3	4	5	5	6	6	7																	
Y: (Dependent variable)																										
3a	Differentiate between Supervised and Unsupervised Learning with Examples.	3	CO2	L2	1																					
3b	Write and Explain the k-means clustering algorithm.	2	CO2	L2	2																					
4	<p>Consider a simple example with four instances shown in table and apply locally weighted regression.</p> <table><tr><td>S. N O.</td><td>Salary(in lakhs)</td><td>Expenditure(in thousands)</td></tr><tr><td>1.</td><td>5</td><td>25</td></tr><tr><td>2.</td><td>1</td><td>5</td></tr><tr><td>3.</td><td>2</td><td>7</td></tr><tr><td>4.</td><td>1</td><td>8</td></tr></table>	S. N O.	Salary(in lakhs)	Expenditure(in thousands)	1.	5	25	2.	1	5	3.	2	7	4.	1	8	5	CO2	L2	2						
S. N O.	Salary(in lakhs)	Expenditure(in thousands)																								
1.	5	25																								
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3.	2	7																								
4.	1	8																								
5	<p>Let us consider an example where the five week' sales data (in Thousands) is given as shown in table below. Apply linear regression technique to predict the 7th and 9th month sales.</p> <table><tr><td>Xi (week)</td><td>Yi (Sales in thousands)</td></tr><tr><td>1</td><td>1.2</td></tr><tr><td>2</td><td>1.8</td></tr></table>	Xi (week)	Yi (Sales in thousands)	1	1.2	2	1.8	6	CO2	L2	2															
Xi (week)	Yi (Sales in thousands)																									
1	1.2																									
2	1.8																									

		3	2.6						
		4	3.2						
		5	3.8						

Roll No.:.....

National Institute of Technology Delhi

Name of the Examination: Mid Sem Examination (Oct. 2023)

Branch: (M.Tech. CSE(Aalytics) and M.Tech. (CSE), Ph.D. (for all branches)

Title of the Course: Computational Mathematics

Time: 1.5 Hours

Note:1. Attempt all questions. 2. Read all questions carefully 3. Missing parameters or values may be assumed.

Semester: I

Course Code: CSLM 501

Maximum Marks: 25

Q.No.	1	2	3	4
C.O.	CO1	CO2	CO2	CO1
P.O.	1	2	1	1
B.L.	1	3	2	2

1. (a) A die is loaded in such a way that the probability of the face with j dots turning up is proportional to j for $j = 1, 2, \dots, 6$. What is the probability, in one roll of the die, that an odd number of dots will turn up? (3)
- (b) A pair of four-sided dice is rolled and the sum is determined. What is the probability that a sum of 3 is rolled before a sum of 5 is rolled in a sequence of rolls of the dice? (3)
2. (a) If the events $\{B_i\}_{i=1}^m$ constitute a partition of the sample space S and $P(B_i) \neq 0$ for $i = 1, 2, \dots, m$, then for any event A in S prove that (3)

$$P(A) = \sum_{i=1}^m P(B_i)P(A/B_i)$$

Also prove that for $P(A) \neq 0$

$$P(B_k/A) = \frac{P(B_k)P(A/B_k)}{\sum_{i=1}^m P(B_i)P(A/B_i)}, k = 1, 2, \dots, m$$

- (b) Show that exponential distribution has memoryless property. (2)
- (c) One-half percent of the population has AIDS. There is a test to detect AIDS. A positive test result is supposed to mean that people have AIDS but the test is not perfect. For people with AIDS, the test misses the diagnosis 2% of the times. And for the people without AIDS, the test incorrectly tells 3% of them that they have AIDS. (3)
 - i. What is the probability that a person picked at random will test positive?

- ii. What is the probability that people have AIDS given that their test comes back positive?
3. (a) Find the probability density function of the random variable X whose cumulative distribution function is (3)

$$F(x) = \begin{cases} 0.0 & \text{if } x < -1 \\ 0.25 & \text{if } -1 \leq x < 1 \\ 0.50 & \text{if } 1 \leq x < 3 \\ 0.75 & \text{if } 3 \leq x < 5 \\ 1.00 & \text{if } x \geq 5 \end{cases}$$

Also, find (a) $P(X \leq 3)$, (b) $P(X = 3)$.

- (b) On a five-question multiple-choice test there are five possible answers, of which one is correct. If a student guesses randomly and independently, what is the probability that she is correct only on questions 1 and 4? (3)
4. (a) The probability that a machine produces a defective item is 0.02. Each item is checked as it is produced. Assuming that these are independent trials, what is the probability that at least 100 items must be checked to find one that is defective? (2)
- (b) Let X have a Poisson distribution with parameter $\lambda = 1$. What is the probability that $X \geq 2$ given that $X \leq 4$ (3)

Roll No.:

National Institute of Technology, Delhi

Mid Semester Examination (Autumn Semester 2023)

Branch : CSA
Semester : 1st
Title of the Course : Distributed Databases

Maximum Marks : 25
Time : 1.5 Hours
Course Code : CSBM 662

Note: Read all questions carefully.

Q. No	Questions	Marks	CO	BL	PO																																																																							
1 (a)	Elaborate the scenarios where a database expert prefers a Distributed DBMS over a centralized DBMS and vice-versa.	04	CO1	L1	3																																																																							
(b)	Elaborate through a diagram various components of the Distributed Database Management System.	04	CO1	L2	2																																																																							
(c)	Explain diagrammatically the steps of distributed query processing.	04	CO1	L2	2																																																																							
2.	<p>Given the relation EMP and ASG below:</p> <p>Let p_1: TITLE < “Programmer” and p_2: TITLE > “Programmer” be two simple predicates. Assume that character strings have an order among them based on alphabetical order.</p> <p>EMP</p> <table><tr><th>Eno</th><th>ENAME</th><th>TITLE</th></tr><tr><td>E1</td><td>J. Doe</td><td>Elect. Eng</td></tr><tr><td>E2</td><td>M. Smith</td><td>Sys. Analyst</td></tr><tr><td>E3</td><td>A Lee</td><td>Mech. Eng.</td></tr><tr><td>E4</td><td>J Miller</td><td>Programmer</td></tr><tr><td>E5</td><td>B Caery</td><td>Sys. Analyst</td></tr><tr><td>E6</td><td>L Chu</td><td>Elect. Eng</td></tr><tr><td>E7</td><td>R Davis</td><td>Mech. Eng.</td></tr><tr><td>E8</td><td>J Jones</td><td>Sys. Analyst</td></tr></table> <p>ASG</p> <table><tr><th>ENO</th><th>PNO</th><th>RESP</th><th>DUR</th></tr><tr><td>E1</td><td>P1</td><td>Manager</td><td>12</td></tr><tr><td>E2</td><td>P1</td><td>Analyst</td><td>24</td></tr><tr><td>E2</td><td>P2</td><td>Analyst</td><td>6</td></tr><tr><td>E3</td><td>P3</td><td>Consultant</td><td>10</td></tr><tr><td>E3</td><td>P4</td><td>Engineer</td><td>48</td></tr><tr><td>E4</td><td>P2</td><td>Programmer</td><td>18</td></tr><tr><td>E5</td><td>P2</td><td>Manager</td><td>24</td></tr><tr><td>E6</td><td>P4</td><td>Manager</td><td>48</td></tr><tr><td>E7</td><td>P3</td><td>Engineer</td><td>36</td></tr><tr><td>E8</td><td>P3</td><td>Manager</td><td>40</td></tr></table> <p>(a) Perform a horizontal fragmentation of relation EMP with</p>	Eno	ENAME	TITLE	E1	J. Doe	Elect. Eng	E2	M. Smith	Sys. Analyst	E3	A Lee	Mech. Eng.	E4	J Miller	Programmer	E5	B Caery	Sys. Analyst	E6	L Chu	Elect. Eng	E7	R Davis	Mech. Eng.	E8	J Jones	Sys. Analyst	ENO	PNO	RESP	DUR	E1	P1	Manager	12	E2	P1	Analyst	24	E2	P2	Analyst	6	E3	P3	Consultant	10	E3	P4	Engineer	48	E4	P2	Programmer	18	E5	P2	Manager	24	E6	P4	Manager	48	E7	P3	Engineer	36	E8	P3	Manager	40	08	CO2	L2	2
Eno	ENAME	TITLE																																																																										
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	<p>respect to $\{p_1, p_2\}$.</p> <p>(b) Explain why the resulting fragmentation (EMP_1, EMP_2) does not fulfil the correctness rules of fragmentation.</p> <p>(c) Modify the predicates p_1 and p_2 so that they partition EMP obeying the correctness rules of fragmentation. To do this, modify the predicates, compose all minterm predicates and deduce the corresponding implications, and then perform a horizontal fragmentation of EMP based on these minterm predicates. Finally, show that the result has completeness, reconstruction and disjointness properties.</p> <p>(d) Consider relation ASG given above. Suppose there are two applications that access ASG. The first is issued at four sites and attempts to find the duration of assignment of employees given their numbers. Assume that managers consultants, engineers, and programmers are located at four different sites. The second application is issued at two sites where the employees with an assignment duration of less than equal to 20 months are managed at one site, whereas those with longer duration are managed at a second site. Derive the primary horizontal fragmentation of ASG using the foregoing information.</p>				
3.	<p>Consider the following table EMPLOYEE and DEPARTMENT.</p> <p>Site1: EMPLOYEE (EID, NAME, SALARY, DID)</p> <p>EID- 10 bytes SALARY- 20 bytes DID- 10 bytes Name- 20 bytes Total records- 1000 Record Size- 60 bytes</p> <p>Site2: DEPARTMENT (DID, DEPARTMENT)</p> <p>DID- 10 bytes DName- 20 bytes Total records- 50 Record Size- 30 bytes</p> <p>Find the name of employees and their department names. Also, find the amount of data transfer to execute this query when the query is submitted to Site 3.</p>	5	CO2	L3	3



National Institute of Technology, Delhi
Name of the Examination: Mid-Semester Examination
(Autumn Semester 2023)

Branch: CSE(Ph.D/M.Tech)

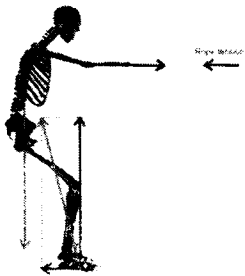
Title of the Course: Motion analytics

Time: 1 hours 30 min

Semester: I

Course Code: CSBM 616

Maximum Marks: 25

Q.no	Question	Marks	CO	BL	PO
Section I: Each question carries 1 mark					
1	Discuss the following a) Kinetic b) Kinematics c) Stride length d) Static Equilibrium e) Biomechanical model of human body	5	1,3	1	PO1
2.	Walking is considered as a series of cyclic events known as gait cycles. Elaborate the above statement and mention the phases in gait cycle.	2	1	2	1
3.	How one can categorize the parameters in gait analysis. Discuss how these features can be extracted for the gait analysis.	3	1,2,3	2	1,2
4.	a) If an individual stands with flat feet they will have lower pressures on the foot than an individual with arched feet as the area over which the force is distributed is larger. Justify the given statement. b) If a subject of weight (force) 700 N stands on block and the area beneath the foot in contact with the block with a side of 4 cm then find the average pressure beneath the area of the foot in contact with the block.	5	2	3	2
5.	With the help of the diagram, analyze the anatomical positions of human with three reference planes.	5	1	4	1
6.	Assuming that the two people are same weight and height and that they are in identical positions and that they are in static equilibrium. The resultant force beneath the feet is 900 N and the angle of the force acts to the vertical is 30 degrees. Find the Tension in the rope. What should be the mass of the person for the Static Equilibrium condition. 	5	2	3,5	1

Course no: CSBM 505
Course Title: Data Mining and Warehousing
Mid Semester
Date: 10 October,2023

Q No	Questions	Marks	CO	B L	PO																														
1	<p>a. Compute the Dissimilarity between the objects</p> <p>Table T1</p> <table><tr><th>Object ID</th><th>Test1</th><th>Test2</th><th>Test3</th><th>Test4</th><th>Gender</th></tr><tr><td>1</td><td>68</td><td>Medium</td><td>B</td><td>Negative</td><td>M</td></tr><tr><td>2</td><td>90</td><td>Large</td><td>C</td><td>Positive</td><td>F</td></tr><tr><td>3</td><td>10</td><td>XLarge</td><td>A</td><td>Negative</td><td>F</td></tr><tr><td>4</td><td>30</td><td>Small</td><td>A</td><td>Positive</td><td>M</td></tr></table>	Object ID	Test1	Test2	Test3	Test4	Gender	1	68	Medium	B	Negative	M	2	90	Large	C	Positive	F	3	10	XLarge	A	Negative	F	4	30	Small	A	Positive	M	3	CO2	3	1,2,3,5, 6,11,12
Object ID	Test1	Test2	Test3	Test4	Gender																														
1	68	Medium	B	Negative	M																														
2	90	Large	C	Positive	F																														
3	10	XLarge	A	Negative	F																														
4	30	Small	A	Positive	M																														
	<p>b. For the following data points</p> <table><tr><th>Point</th><th>X</th><th>Y</th></tr><tr><td>P1</td><td>0</td><td>2</td></tr><tr><td>P2</td><td>2</td><td>0</td></tr><tr><td>P3</td><td>3</td><td>1</td></tr><tr><td>P4</td><td>5</td><td>1</td></tr></table> <p>Generate the distance matrix using Euclidean, Manhattan, Minkowski and Supremum Distances and interpret the results obtained using graphs</p>	Point	X	Y	P1	0	2	P2	2	0	P3	3	1	P4	5	1	4	CO2	3	1,2,3,5, 6,11,12															
Point	X	Y																																	
P1	0	2																																	
P2	2	0																																	
P3	3	1																																	
P4	5	1																																	
2	The theory predicts the proportion of beans, in four groups A, B, C and D should be 9:3:3:1. In an experiment among 1600 beans, the numbers in the four groups were 882,313,287 and 118. Does the experiment result support the theory? Apply Chi square	3	CO2	3	1,2,3,5, 6,11,12																														
3	a. What are the objectives of PCA? How do you perform Principal Component analysis for Dimensionality Reduction?	2	CO1	2	1,2,3,4, 6,7,12																														
	b. What is the difference between a Variance-Covariance matrix and a Correlation Matrix.	2	CO1	2	1,2,3,4, 6,7,12																														
	c. What is the difference between a Variance-Covariance matrix and Correlation Matrix.	2	CO1	2	1,2,3,4, 6,7,12																														
	d. Given the correlation matrix $R=\begin{bmatrix} 1 & 0.9 \\ 0.9 & 1 \end{bmatrix}$ Compute the eigenvalues and corresponding eigenvectors of R	2	CO2	2	1,2,3,5, 6,11,12																														
	e. Differentiate between Snowflake and Fact Constellation Schema	2	CO1	2	1,2,3,4, 6,7,12																														
4.	<p>Test scores for a college statistics class held during the day are:</p> <p>99; 56; 78; 55.5; 32; 90; 80; 81; 56; 59; 45; 77; 84.5; 84; 70; 72; 68; 32; 79; 90</p> <p>i. Find the smallest and largest values, the median, and the first and third quartile for the day class.</p> <p>ii. For the data set, what percentage of the data is between the smallest value and the first quartile? the first quartile and the median? the median and the third quartile? the third quartile and the largest value? What percentage of the data is between the first quartile and the largest value?</p> <p>iii. Create a box plot for the data. Use one number line for box plot.</p>	3	CO2	3	1,2,3,5, 6,11,12																														
5	Differentiate between OLAP and OLTP	2	CO1	1	1,2,3,4, 6,7,12																														

National Institute of Technology, Delhi

Name of the Examination: M.Tech First Year (AY 2023-2024)

Mid Semester Examination

Branch : CSE/CSA Semester : I

Title of the Course : Advanced Data Structure and Algorithms

Course Code : CSBM502

Time: 1.5 Hours

Maximum Marks: 25

Note: 1. The Question1 is mandatory. (1 Marks)

2. Attempt ANY EIGHT questions from question number 2 to 10. (3 Marks each)

Q No	Question	Marks	CO	BL	PO
1	Justify the chronology between Computer Science, Computer and Algorithms.	1	1,2	1	1-5
2	Find the complexity of following program code. Show the analysis in detail. A() { int n=2 ^{2k} ; for (i=1;i<=n;i++) { j=2 while(j<=n) { j=j ² ; pf(" "); } } }	3	2,3	2	1-5
3	Find the complexity of $T(n)=7T(n/3)+n^2$ using masters theorem. Specify the condition and case number clearly.	3	2,3	2	1-5
4	What is the competitive ratio of Algorithm A_4 in case of Ski buy or rent problem? (You can either rent ski for \$50 or buy for \$500). Which algorithm is more competitive A_4 or A_5 ?	3	2,3	2	1-5
5	Consider a disjoint data set $S = \{0, 1, 2, 3, 4, 5\}$. Initially all the subsets have a single element and each element is a ROOT of itself. (a) Show the balance tree which will reduce complexity of union and find function to $\log_2 N$. Represent the tree and array at each step. (b) Can this complexity be improved more? If yes, specify the name of the algorithm and justify your answer.	3	2,3	2	1-5

6	<p>Let S_i is the size of the table and C_i be the cost of i^{th} iteration in Accounting method. $C_i = i$; if $i-1$ is a power of 2; 1 otherwise. Cost involved for insertion of one element is 1 Unit. Cost involved for insertion of one element and move when table is doubled is 3 Unit. If b_i is the balance after i^{th} iterations, complete the following table:</p> <table><tr><td>i</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr><tr><td>S_i</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>C_i</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>C_i'</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>b_i</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>	i	1	2	3	4	5	6	7	8	9	10	S_i											C_i											C_i'											b_i											3	2,3	2	1-5
i	1	2	3	4	5	6	7	8	9	10																																																		
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C_i'																																																												
b_i																																																												
7	Match the string “AAAA” in the text “AAAAABAAABA” using KMP algorithm. Show the value of lps, loop variables and length at each step. What is the best case and worst case of pattern searching algorithm?	3	2,3	2	1-5																																																							
8	Specify the lower bound on streak length by showing that in N flips of a fair coin, the probability is less than $1/n$ that no streak longer than $(\lg n - 2\lg \lg n)$ consecutive heads occur.	3	2,3	2	1-5																																																							
9	Explain the naive approach of Insertion, Deletion and Search operations of k-d tree. Write the time complexity (Best, Average and Worst) and Space complexity in each case.	3	2,3	2	1-5																																																							
10	What is Maximum flow problem? Explain Ford Fulkerson method with example.	3	2,3	2	1-5																																																							