M.Sc.(AI).I/11.23.001 Reg.No. | | | | | | | | |

B

M.SC. COMPUTER SCIENCE WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE
FIRST SEMESTER EXAMINATION NOVEMBER 2023

23-344-0101 MATHEMATICS FOR AI

(Regular)

Time: 3 Hrs. **Maximum Marks: 50**

Each question carries 10 Marks

Qn No		Questions	Marks	CO	BL	PI
1	a	Let A = {4, 3,1 2, 5,6} and R = {(1, 1), (1, 3), (2, 2), (2, 4), (3, 1), (3, 3), (4, 2), (4, 4)}. Show that R is a partial order Relation on A.	5	CO1	L3	1.1.1
	b	In a class of 40 students, 20 have chosen Mathematics, 15 have chosen mathematics but not biology. If every student has chosen either mathematics or biology or both a) Compute the number of students who chose both mathematics and biology. b) Compute the number of students who chose biology but not mathematics.	5	CO1	L3	1.1.2
		OR				
2	a	Prove the following using the Principle of Mathematical Induction. $1^2 + 3^2 + 5^2 + \cdots + (2n-1)^2 = \frac{n(2n-1)(2n+1)}{3}$	5	CO1	L3	1.1.1
	b	Prove the following using the Principle of Mathematical Induction $p(n) = 1 + 3 + 3^2 + \cdots + 3^{n-1}$ $= \frac{3^n - 1}{2}$ *is true* $\forall n \in N$	5	CO1	L3	1.1.1

3	a	Consider the following system of equations: (a) For which values of a and b does it have no solution? (b) For which values of a and b does it have a unique solution? (c) For which values of a and b does it have infinitely many solutions? $$x_1 + x_2 = b$$ $$-2x_1 + ax_2 = 1$$	6	CO2	L3	1.3.1
	b	Determine whether the following set of vectors are sub-spaces of R3? Justify your answer (i) W = {(x, y, z): } (ii) T = {(x, y, z): }	4	CO2	L3	1.1.2
		OR				
4	a	Compute the complete solution for the following system of equations $$x_1 - x_2 - x_3 + x_4 = 0$$ $$2x_1 - 2x_2 + x_3 + x_4 = 0$$ $$5x_1 - 5x_2 - 2x_3 + 4x_4 = 0$$	5	CO2	L3	1.1.1
	b	Consider the following matrix A: $$A = \begin{bmatrix} a & 1 & 1 \\ 1 & a & 1 \\ 1 & 1 & a \end{bmatrix}$$ (a) For what values of a does it have rank = 1? (b) For what values of a does it have rank = 2? (c) For what values of a does it have rank = 3?	5	CO2	L3	1.1.2
5		Consider the following matrix A $$A = \begin{bmatrix} 1 & 1 & 4 & 1 & 2 \\ 0 & 1 & 2 & 1 & 1 \\ 0 & 0 & 0 & 1 & 2 \\ 1 & -1 & 0 & 0 & 2 \\ 2 & 1 & 6 & 0 & 1 \end{bmatrix}$$ (a) Compute a basis for the row space of A (b) Compute a basis for the column space of A (c) Compute a basis for the null space of A (d) Verify Rank-Nullity theorem	10	CO3	L3	1.1.2

		OR				
6	a	Compute the eigenvalues and eigenvectors of the following matrix A in terms of k $$A = \begin{bmatrix} 1 & k \\ 2 & 1 \end{bmatrix}$$	5	CO3	L3	1.1.2
	b	Compute the Reduced Row Echelon Form of the following matrix A $$A = \begin{bmatrix} 1 & 0 & 0 & 3 & 4 \\ 0 & 6 & -3 & -3 & 0 \\ 0 & 3 & 0 & -2 & 1 \\ 2 & -1 & 4 & 0 & 5 \end{bmatrix}$$	5	CO3	L3	1.1.1
7	a	Solve the following optimization problem using Lagrange Multipliers method: $$\min_{x_1,x_2,x_3} x_1^2 + x_2^2 + x_3^2 - 10x_1 - 6x_2 - 4x_3 = 0$$ $$subject\ to\ x_1 + x_2 + x_3 = 7$$	5	CO4	L3	1.1.2
	b	Check whether the following function is convex or not $$x_1^2 + x_2^2 + x_3^2 - 10x_1 - 6x_2 - 4x_3 = 0$$	5	CO4	L3	1.1.2
		OR				
8		In a study of the relationship between an independent variable (X) and a dependent variable (Y), the following data was gathered: X: 56, 75, 61, 63, 67, 72, 62, 64 Y: 21, 39, 34, 21, 32, 24, 29, 24 Fit a simple linear regression model for the above data. Also, predict the value of dependent variable Y, when the value of the independent variable (X) is 69.	10	CO4	L3	1.1.1
9	a	Solve the following recurrence relation using Substitution Method $$T(n) = \begin{cases} 1, & \text{if } n = 1. \\ T(\frac{n}{2}) + c, & \text{if } n > 1. \end{cases}$$	5	CO5	L3	1.1.2

	b	Solve the following recurrence relation using Substitution Method $$T(n) = \begin{cases} 1, & \text{if } n = 1. \\ T(n-1) + \log n, & \text{if } n > 1. \end{cases}$$	5	CO5	L3	1.1.2
		OR				
10	a	Solve the following equation: $F_n = 6F_{n-1} - 5F_{n-2}$, where $F_0 = 1$ and $F_1 = 4$	3	CO5	L3	1.1.2
	b	Solve the given equation: $F_n = 4F_{n-1} + 10F_{n-2} + 7.5^n$, where $F_0 = 4$ and $F_1 = 3$	5	CO5	L3	1.1.2
	c	Find the characteristic equation and characteristic root of the following equation: $a_k - 7a_{k-1} + 12a_{k-2} = 0$	2	CO5	L3	1.1.2

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B

M.SC. COMPUTER SCIENCE WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE
FIRST SEMESTER EXAMINATION NOVEMBER 2023

23-344-0104 - STATISTICS FOR ARTIFICIAL INTELLIGENCE

(Regular)

Time: 3 Hours **Maximum Marks :50**

Each question carries 10 Marks

No		QUESTIONS	MARKS	CO	BL	PI
1	a.	If X be a normal variable with mean μ and standard deviation σ. If Z is the standard normal variable such that $Z=0.8$ when $X=26$ and $Z=2$ when $X=40$, then i. find μ and σ. ii. find $P(X>45)$ and iii. $P(\lvert X-30\rvert>5)$	6	CO1	L3	1.7.1
	b.	If X is a poisson variate with parameter λ such that $P(X=2)=9P(X=4)+90P(X=6)$, then (i) find variance of X (ii) Evaluate $P(X=5)$.	4	CO1	L3	1.7.1
		OR				
2	a.	Let X be a random variable with the following probability distribution X: -3, 6, 9 $P(X=x)$: $\frac{1}{6}$, $\frac{1}{2}$, $\frac{1}{3}$ Evaluate $E(2X+1)^2$	5	CO1	L3	1.7.1
	b.	In a simultaneous inspection of 10 units, the probabilities of getting a defective unit and non-defective unit are equal. Find the probability of getting: i. at least 7 non-defective units ii. at most 6 defective units and iii. at least 2 non-defective units	5	CO1	L3	1.7.1
3	a.	Find the co-efficient of correlation between x and y for the following data if the co-efficient of correlation r between x	6	CO2	L3	1.7.1

		and y is given by $$r=\frac{\sigma^2_{x+y}-\sigma^2_x-\sigma^2_y}{2\sigma_x\sigma_y}$$ where $\sigma^2_x,\sigma^2_y,\sigma^2_{x+y}$ are the variances of x, y and $x+y$ respectively.				
	b.	Explain the significance of correlation. How will you interpret the values of the given correlation matrix. 		X	Y	Z
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X	1.0	0.3	-0.5
Y	0.3	1.0	0.6
Z	-0.5	0.6	1.0		4	CO2	L3	1.7.1
		OR				
4	a.	Explain the significance of Skewness and Kurtosis in EDA.	3	CO2	L2	2.5.3
	b.	For a distribution Karl Pearson's coefficient of skewness is 0.72, standard deviation is 11 and mean is 57.2, find mode and median?	3	CO2	L3	2.5.3
	c.	Consider the *marks* obtained by 10 students in a mathematics test as given below: | 55	36	95	73	60	45	25	78	75	62 | Describe the variable *marks* using summary statistics.	4	CO2	L3	2.5.3
5		The following table represents the joint probability distribution of the discrete random variable (X, Y). 	Y \ X	1	2	3
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1	$\frac{1}{12}$	$\frac{1}{6}$	0
2	0	$\frac{1}{9}$	$\frac{1}{5}$
3	$\frac{1}{18}$	$\frac{1}{4}$	$\frac{2}{15}$		10	CO3	L3	2.5.3
	a.	Find all the marginal distributions of X and Y.				
	b.	Find the Conditional pdf Y given X=1 and X given Y=2.				
		OR				
6	a.	Jorge asked each of the 24 students in his class if they play a musical instrument. He also asked each student if they play a sport. He gathered the following results: 6 students play both a musical instrument and a sport.	4	CO3	L3	2.5.3

		3 students play neither a musical instrument nor a sport. 14 students in total play a sport. Can you help Jorge to organize the results into a two-way frequency table?				

	Plays a sport	Does not play a sport
Plays a musical instrument		
Does not play a musical instrument		

	b.	The two-way table shows the distribution of members of the audience at a play	6	CO3	L3	2.5.3

	Stalls	Circle	Balcony	Total
Adults	36	39		112
Children	41		31	
Total		60		

(i) Complete the two way table.

(ii) What is the probability that a randomly chosen audience member is an adult and is seated on the balcony?

7	a.	A manufacturer of ball pens claims that a certain pen he manufactures has a mean writing life of 500 pages with a standard deviation of 20 pages. A purchasing agent selects a sample of 150 pens and puts them for test. The mean writing life for the sample was 390 pages. Should the purchasing agent reject the manufactures claim at 5% level?	6	CO4	L3	2.8.4
	b.	Suppose the null hypothesis, H_0 , is: Frank's rock climbing equipment is safe. (i) State the Type I and Type II errors for given hypothesis H_0. (ii) Which type of error has the greater consequence, Type I or Type II? Explain why?	4	CO4	L3	2.8.4
		OR				
8	a.	An insurance company sells health insurance and motor insurance policies. Customers pay premiums for these policies. The CEO of the insurance company wonders if premiums paid by either of the insurance segments (health insurance and motor insurance) are more variable than another. He finds the following data for premiums paid:	6	CO4	L3	2.8.4

			Health Insurance	Motor Insurance			
		Variance	$200	$50			
		Sample Size	11	51			
		Conduct a two-tailed F-test with a level of significance of 10%.					
	b.	Explain the terms Critical Region and Level of significance.			2	CO4	L2	1.7.1
	c.	How do you reduce the risk of making Type II Error			2	CO4	L2	1.7.1
9		The following data represent the strength and elasticity values based on ten tests. Obtain i. correlation between elasticity and strength ii. the regression equation of elasticity on strength iii. the elasticity when strength is 7.5			10	CO5	L3	2.8.1

Test no.	*Strength(X)*	*Elasticity(Y)*
1	5.40	17
2	6.18	18
3	8.71	21
4	6.28	17
5	7.60	17
6	8.49	16.5
7	5.74	17
8	9.93	17.5
9	8.38	19
10	6.94	13.5

OR

10	In a certain type metal test specimen, *the normal stress* on a specimen is known to be functionally related to the *shear resistance*. The following is a set of coded experimental data on the two variables.(12 observations)	10	CO5	L3	2.8.1

Normal Stress (X)	*Shear Resistance (Y)*
26.8	26.5
25.4	27.3
28.9	24.2
23.6	27.1
27.7	23.6
23.9	25.9
24.7	26.3

28.1	22.5
26.9	21.7
27.4	21.4
22.6	25.8
25.6	24.9

i. Fit a Line of Regression for the above data.

ii. Estimate the shear resistance if the normal stress is 24.5kg/cm^2.

iii. Obtain the Standard Error of Estimate.

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Reference: Z Table

CRITICAL VALUES (z_α) OF Z

Critical Values (z_α)	*Level of significance* (α) 1%	5%	10%
Two-tailed test	$\|Z_\alpha\| = 2.58$	$\|Z_\alpha\| = 1.96$	$\|Z_\alpha\| = 1.645$
Right-tailed test	$Z_\alpha = 2.33$	$Z_\alpha = 1.645$	$Z_\alpha = 1.28$
Left-tailed test	$Z_\alpha = -2.33$	$Z_\alpha = -1.645$	$Z_\alpha = -1.28$

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A

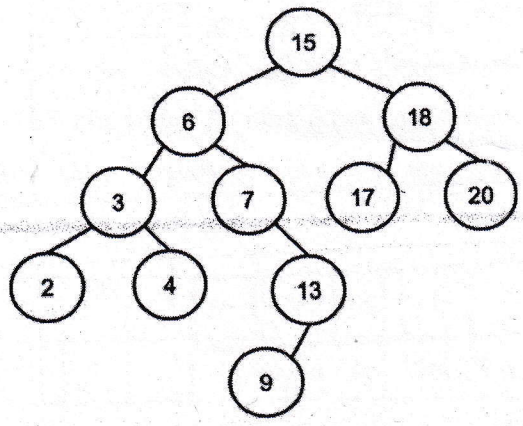
M.SC. COMPUTER SCIENCE WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE FIRST SEMESTER EXAMINATION NOVEMBER 2023

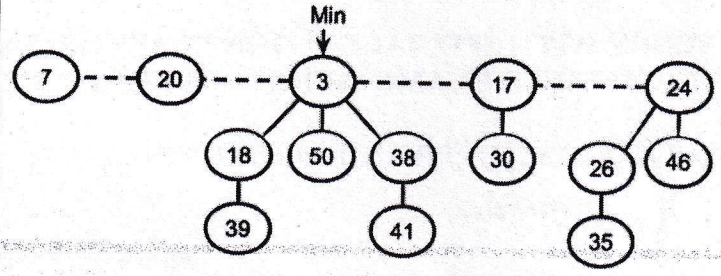
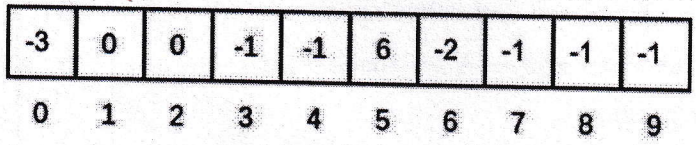
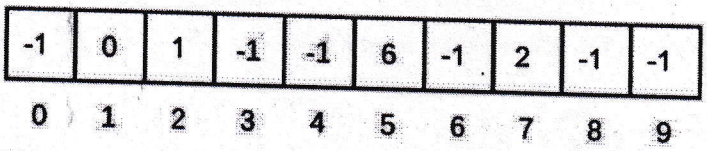
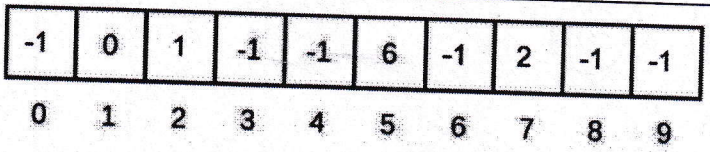
23-344-0103 DATA STRUCTURES AND ALGORITHMS

(Regular)

Time: 3 Hours **Maximum Marks :50**

Each question carries 10 Marks

No		QUESTIONS	MARKS	CO	BL	PI
1		Write an algorithm to perform insert and delete operations on a min-heap implemented on arrays. Also, analyze the time complexity of the algorithm.	10	CO1	L2	1.7.1
		OR				
2		Write an algorithm to find the k-th smallest element of an array of numbers. Analyze the time complexity of your algorithm. Also, discuss the notions of best-case and worst-case in the context of the problem.	10	CO1	L2	1.7.1
3	a.	Write an algorithm to perform enqueue operation on a queue implemented using linked lists.	5	CO2	L2	1.7.1
	b.	Do the following operations on the given binary search tree.  • Left rotation with respect to 7 and 13. • Right rotation with respect to 6 and 15.	5	CO2	L2	1.7.1
		OR				

4		Perform delete() operation on the Fibonacci heap shown below. Show the heap after every intermediate transformation.  	10	CO2	L3	1.7.1
5	a.	 Do the following unions on the disjoint set shown above using union by size. • Union (3,0) • Union (4,6) • Union (8,9) Show the disjoint set after each of the operations.	5	CO3	L3	1.7.1
	b.	Perform Find (7) & Find (5) with path compression in the following disjoint set.  Also, write the algorithm for performing find operations with path compression.	5	CO3	L3	1.7.1
		OR				
6		 Implement the above disjoint sets using linked lists. Write the pseudocode for performing Union and Find operations on the linked list implementation of disjoint sets.	10	CO3	L3	1.7.1

7		Five students applied to four different internship positions within a company. The preferences given by the students are as follows. The students are ordered based on their rank in the qualifying test. Do bipartite matching using Ford-Fulkerson algorithm and find the maximum matching.	10	CO4	L3	1.7.1

Student	Positions
S1	P1, P3
S4	P1
S3	P4
S2	P2, P3
S5	P3, P4

OR

8		Compute the convex hull of the following set of points using Graham's scan algorithm. (1,1), (9,2), (10,3), (7,8), (6,7), (4,11), (1,9), (11,7), (3,8) & (2,8).	10	CO4	L3	1.7.1
9		Encode the character string CABDIG using Huffman codes. The character frequency table is as follows. How much space could be saved here in comparison with the fixed length encoding of the string?	10	CO5	L3	1.7.1

Character	A	B	C	D	E	F	G	H	I
Frequency (%)	19	3	7	4	21	15	6	20	5

OR

10	a.	A multi-processing environment with three processors is given a set of jobs whose running times are as shown in the table below. Do a greedy scheduling of the jobs. Is your schedule optimal? Justify your answer.	6	CO5	L3	1.7.1

Job	J1	J2	J3	J4	J5	J6	J7	J8	J9
Time	3	5	7	9	11	14	15	18	20

	b.	Do bin packing with items having sizes 0.5, 0.6, 0.7, 0.1, 0.4, 0.2, 0.7, 0.5, 0.1, 0.8, 0.4, 0.9, 0.3 & 0.1 using First-fit (Online) and Best-fit (Online). Assume a bin size of 1.5.	4	CO5	L3	1.7.1

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C

M.SC. COMPUTER SCIENCE WITH SPECIALIZATION IN ARTIFICIAL INTELLIGENCE FIRST SEMESTER EXAMINATION NOVEMBER 2023

23-344-0105 ADVANCED COMPUTER NETWORKS

Regular

Time: 3 Hours **Maximum Marks :50**

Each question carries 10 Marks

No		QUESTIONS	MARKS	CO	BL	PL
1		How do CSMA, CSMA/CD and CSMA/CA differ in their mechanisms and functionalities, and in what scenarios are each of these protocols commonly applied within network communications?	10	CO1	L2	1.7.1
		OR				
2		What are the various types of transmission media, and how do they differ in terms of their characteristics and applications?	10	CO1	L2	1.7.1
3		Calculate the checksum for the given data (Divide the data into segments of 8 bits): 10011001111000100010010010000100	10	CO2	L3	2.5.3
		OR				
4		A bit stream 10011101 is transmitted using the standard CRC method. The generator polynomial is x^3+1. 1.What is the actual bit string transmitted? 2.Suppose the third bit from the left is inverted during transmission, how will receiver detect this error?	10	CO2	L3	2.5.3
5		What is OSPF (Open Shortest Path First), and how does it function as a routing protocol in computer networks?	10	CO3	L2	1.7.1
		OR				
6		Describe the process of subnetting in IP networking. Subnet the IP address 216.21.5.0 into 30 hosts in each subnet.	10	CO3	L3	2.5.3
7		What is a TCP (Transmission Control Protocol) connection, and how does it establish and maintain reliable communication between devices in a network? Elucidate the key elements and processes involved in TCP connections.	10	CO4	L2	1.7.1

		OR				
8		What is Congestion Control in TCP (Transmission Control Protocol), and how does it play a crucial role in managing network congestion?	**10**	**CO4**	**L2**	**1.7.1**
9		How does DNS (Domain Name System) serve as the internet's directory service?	**10**	**CO5**	**L2**	**1.7.1**
		OR				
10		What are the core principles of network applications?	**10**	**CO5**	**L2**	**1.7.1**

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