UMT

University of Management and Technology,

Lahore Campus

Mid Exam –Fall 2025

Course Title:	Discrete Structures	**Course Code:**	CC-141
Course instructor/s:	Syed Hamed Raza	**Program Name:**	BS Computer Science
Semester:	BS(CS)	**Maximum Marks:**	40
Section:		**Time Allowed**	1 Hour 10 mins
Exam Date:		**Moderator Signature:**	
Student Name:		**Registration ID:**	

Important Instructions / Guidelines

- Attempt all the questions
- Understanding of paper is a part of an assessment
- Write down only specific answers and restrain from irrelevant descriptions.
- Please turn off all electronic devices, including phones and smartwatches, and place them in your bag or on the floor beside your desk.
- This is a closed-book exam. You are not allowed to use any notes, textbooks, or other materials during the exam.
- Please make sure to write your name and student ID on the front page of your exam paper.
- Read each question carefully and make sure that you understand what is being asked before you start writing your answer.
- Be mindful of the time and pace yourself accordingly. You are responsible for managing your time during the exam.

Good luck on your exam!

Marks Distribution:

Questions	CLO's	Total Marks	Obtained Marks
Q # 01	CLO 1	**10**	
Q # 02	CLO 2	**5**	
Q # 03	CLO 3	**5**	
Q # 04	CLO 3	**20**	
Total		**40**	

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Q.1: (CLO-1: Understanding) (10 Marks)

1. Given $z = 2.5$, compute the **sigmoid activation** $\sigma(z)$.

2. Given $w = [1, -2]$, $x = [3, 1]$, and $b = 0.5$, compute the **logit** $z = w^T x + b$.

3. Using the result of Question 2, compute the **logistic regression probability** $\hat{y}$.

4. Given $\hat{y} = 0.8$ and $y = 1$, compute the **squared error loss** $E = \frac{1}{2}(\hat{y} - y)^2$.

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5. Given inputs $x = [1,\ 2]$and weights $w = [0.5,\ 0.5]$, compute the **linear combination** z.

Q.2: (CLO-2: Apply) (5 Marks)

Consider the following activation functions:

- **Sigmoid:** $\sigma(z) = \frac{1}{1+e^{-z}}$
- **Tanh:** $\tanh(z)$
- **ReLU:** $\text{ReLU}(z) = \max(0, z)$
- **Leaky ReLU:** $\text{LReLU}(z) = \max(0.01z, z)$

(a) Compute the **activation values** of each function for $z = -20,\ 0,\ 50$.

Solution:

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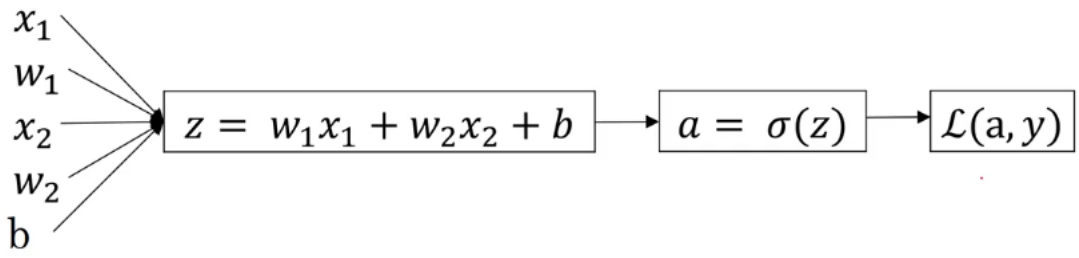
Q.3: (CLO-2: Apply) (5 Marks)

Consider a single-neuron model as shown in the diagram



Given:

- $x_1 = 2,\ x_2 = 1$
- $w_1 = 0.5,\ w_2 = -1$
- $b = 0.1$
- Activation function: $\sigma(z) = \frac{1}{1+e^{-z}}$
- True label: $y = 1$
- Loss function (log loss):

$$\mathcal{L}(a, y) = -[y\log(a) + (1-y)\log(1-a)]$$

Task:

Compute the loss $\mathcal{L}(a, y)$.

Solution:

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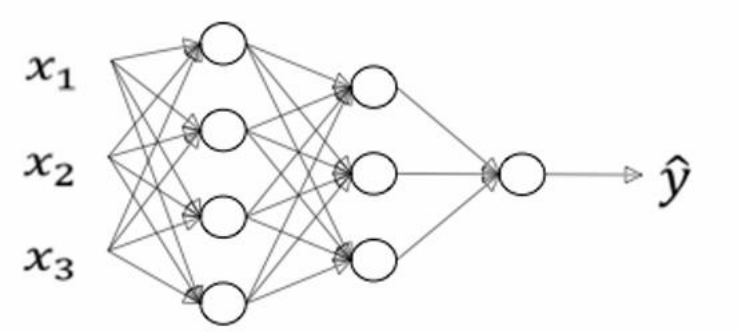
Q.4: (CLO-2: Apply) (20 Marks)

Consider the fully connected feedforward neural network shown in the diagram. The network consists of



Given

Input Vector

$$\mathbf{x} = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 1 \\ 2 \\ -1 \end{bmatrix}$$

Parameters: Input → Hidden Layer 1

$$W^{[1]} = \begin{bmatrix} 0.2 & -0.1 & 0.4 \\ -0.3 & 0.5 & 0.1 \\ 0.6 & -0.2 & -0.4 \\ 0.1 & 0.3 & 0.2 \end{bmatrix}, \quad b^{[1]} = \begin{bmatrix} 0.1 \\ 0.2 \\ 0.0 \\ -0.1 \end{bmatrix}$$

Parameters: Hidden Layer 1 → Hidden Layer 2

$$W^{[2]} = \begin{bmatrix} 0.3 & -0.5 & 0.2 & 0.1 \\ -0.2 & 0.4 & 0.6 & -0.3 \\ 0.5 & 0.1 & -0.4 & 0.2 \end{bmatrix}, \quad b^{[2]} = \begin{bmatrix} 0.0 \\ 0.1 \\ -0.2 \end{bmatrix}$$

Parameters: Hidden Layer 2 → Output Layer

$$W^{[3]} = \begin{bmatrix} 0.4 & -0.6 & 0.5 \end{bmatrix}, \quad b^{[3]} = 0.2$$

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Activation Functions

- **Hidden layers:**

$$\text{ReLU}(z) = \max(0, z)$$

- **Output layer:**

$$\sigma(z) = \frac{1}{1 + e^{-z}}$$

Task

Compute the linear output $z^{[3]}$and final prediction $\hat{y}$at the **Output Layer**.

Solution:

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