COMSATS UNIVERSITY ISLAMABAD (CUI)

DEPARTMENT OF COMPUTER SCIENCE
TERMINAL EXAMINATION FALL - 2025
BS (AI) / BRG – IV SEMESTER

Course: AIC 270 – Programming for AI **Instructor:** *Dr. Muhammad. Usman Yaseen*
Maximum Marks: 50 **Dated:** December 27, 2025 **Time Allowed:** 180 Minutes

- *All questions are self-explanatory and require no further explanations during exam time.*
- *Make sure that you have signed the attendance sheet before leaving the examination room.*
- *Return the question paper along with the answer sheet.*
- *Attempt all questions.*

CLO – 1: Apply fundamental programming constructs to solve basic computational problem

Q. # 1. Euclidean distance is a widely used measure in many AI-based algorithms. Using any two lists of your choice, compute the Euclidean distance between them. **[02 Marks]**

Q. # 2. Design an **AI-oriented input processing loop** that continuously accepts numerical data samples (e.g., sensor readings or feature values) from the user **until a sentinel value of 0 is encountered**, and then computes the **minimum value** among all the collected inputs. **[02 Marks]**

Q. # 3. Write a program that defines a function calculation() which **accepts a NumPy vector of numerical features**, validates its dimensionality, and computes the **average using NumPy's vectorized operations**. **[02 Marks]**

Q. # 4. Dry run the following Python programs and write output. **[04 Marks]**

r = 10
for i in range(r):
  print(i % 2 == 0)
	while(i < 10):
	  i = i + 1
	  r = i % 2
	  if r == 0:
	  print("even")
	  else:
	  print("odd")
		def foo(e):
		  if e >= 10:
		  r = e // 2
		  while(True):
		  i = r
		  while(r > 0):
		  print("Hello")
		  r = r - 1
		  break
		foo(11)
		foo(9)
			f = True
			g = False
			h = True
			print(f or g and not h)

CLO– 2: Develop and use classes and objects, employing object oriented programming principles to create modular and scalable code.

Q. # 5. Write a Python program that **follows the Object-Oriented Programming paradigm** to simulate a **Dice Rolling Game**. The program should define appropriate classes for the game and players, allow Player 1 to roll a dice, generate a random dice roll for Player 2, compare the outcomes using the rule that **the player with the higher number wins (same numbers result in a tie)**, and display the final result. **[05 Marks]**

Q. # 6. Write a Python program that **uses the Object-Oriented Programming (OOP) paradigm** to perform **data binning and statistical analysis** on numerical inputs. The program should define a class (e.g., `BinningAnalyzer`) that: **[05 Marks]**

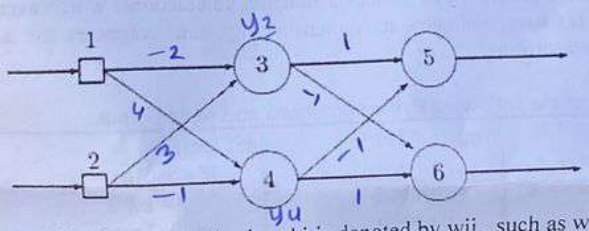
- Prompts the user to enter the value of **n** (total number of integers)
- Accepts **n integers** in the range **[1–1000]**
- Categorizes the input values into the following bins:
  - **Bin-1:** < 200
  - **Bin-2:** 200 – 399
  - **Bin-3:** 400 – 599
  - **Bin-4:** 600 – 799
  - **Bin-5:** 800 – 1000
- Computes the **count and percentage** of values falling into each bin using class methods

Q. # 7. Write Python code using Pandas to load the students.csv file into a DataFrame, display the first three rows, list the unique departments, filter and display records where the GPA is greater than 3.0, and sort the DataFrame by GPA in descending order. The file contains the following features: **[05 Marks]**

StudentID (integer), Name (string), Department (string), GPA (float), Credits (integer)

(CLO– 3: Clarify deep learning techniques for building AI applications.)

Q. # 8. The following diagram represents a feed-forward neural network with one hidden layer: **[05 Marks]**



A weight on connection between nodes i and j is denoted by wij , such as w13 is the weight on the connection between nodes 1 and 3. The following table lists all the weights in the network:

$w_{13} = -2$	$w_{35} = 1$
$w_{23} = 3$	$w_{45} = -1$
$w_{14} = 4$	$w_{36} = -1$
$w_{24} = -1$	$w_{46} = 1$

Each of the nodes 3, 4, 5 and 6 uses the following activation function:

$$\varphi(v) = \begin{cases} 1 & \text{if } v \geq 0 \\ 0 & \text{otherwise} \end{cases}$$

where v denotes the weighted sum of a node. Each of the input nodes (1 and 2) can only receive binary values (either 0 or 1). Calculate the output of the network (y5 and y6) for each of the input patterns:

Pattern:	P_1	P_2	P_3	P_4
Node 1:	0	1	0	1
Node 2:	0	0	1	1

Q. # 09. Can a neural network be used to model the following machine learning algorithms? If so, state the neural network structure (how many hidden layers are required) and the activation function(s) used at the internal and output nodes. If not, describe why not. **[05 Marks]**

(a) Linear regression
(b) Logistic regression
(c) L1-regularized logistic regression
(d) State why non-linearity is important for neural networks ?
(e) Why mean square error (i.e. cost function of perceptron) may not be useful to learn neurons?

Q. # 10. Suppose we have the following composite function: **[05 Marks]**

$$f(x) = \sin(3x^2 + 2x)$$

We can apply the chain rule to find the derivative $f'(x)$. The chain rule states that if you have a composition of functions $f(x) = g(h(x))$, then derivative is given by $f'(x) = g'(h(x)).h'(x)$ We can break it down like $g(u) = \sin(u)$ and $h(x) = (3x^2 + 2x)$. Calculate it using chain rule. Once you have the derivative, also calculate its second derivative.

Q. # 11. Pass the following RGB image through the convolution layer include operations in sequence Convolution-> ReLU-> Max Pooling, and compute the output. Show all your working. **[10 Marks]**

Input Image

1	0	-1	2	0
-2	1	1	0	1
0	1	-1	2	2
0	0	-1	1	1
-1	2	1	0	0

-1	2	2	0	1
-1	2	0	1	0
1	0	1	-2	1
1	0	0	-1	2
-1	1	1	0	0

0	0	-1	1	2
1	2	-1	0	2
2	0	1	-1	0
0	1	-1	0	1
1	1	1	-2	0

Filter

0	0	1
1	2	0
1	-1	0

2	1	0
0	0	1
-1	1	0

-1	0	1
2	0	1
0	1	0

*****BEST OF LUCK*****