COMSATS UNIVERSITY ISLAMABAD
DEPARTMENT OF COMPUTER SCIENCE
Terminal Examination, Fall 2023

Class/Section: - BS(AI) – 5A / BS(DS) – 6A
Subject: - Machine Learning Fundamentals (AIC 354)
Instructor: - Dr. Muhammad Usman Yaseen

Marks: - 50
Time: - 180 minutes
Dated: - 09 January , 2024

Instructions:
Solve all questions
Be precise and to the point in all questions.
Perform all the necessary steps on Answer Sheets

---CLO -1---
Explain learning paradigms along with task and applications.

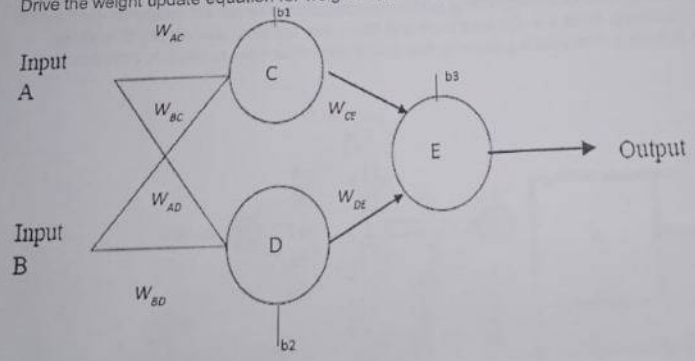
Question# 01: - **(2 marks)**
You are evaluating the performance of a binary classification model for predicting whether a given email is spam or not. The confusion matrix for the model is as follows: Compute the accuracy and precision of the model based on the provided confusion matrix.

	Predicted Labels	
	Predicted Spam	Predicted Non-Spam
Actual Labels		
Actual Spam	150	50
Actual Non-Spam	20	780

Question # 02: - **(3 marks)**
Define bias and variance in the context of machine learning. Explain how a model with a high bias and low variance might perform on training and test datasets.

---CLO -2---
Apply supervised learning techniques to solve classification problems.

Question # 03: - **(5 marks)**
Drive the weight update equation for weight W_{DE} in the following network and show your work.



CLO -3

Apply unsupervised learning techniques to solve clustering problems.

Question # 04: - **(5 marks)**

Consider the following dataset with eight data points:
Data Point 1: (2, 10) Data Point 2: (2, 5) Data Point 3: (8, 4) Data Point 4: (5, 8) Data Point 5: (7, 5) Data Point 6: (6, 4) Data Point 7: (1, 2) Data Point 8: (4, 9)

Perform k-means clustering on this dataset with k=3. Initial centroids are: Centroid 1: (3, 9) Centroid 2: (6, 5) Centroid 3: (2, 3). Perform three iterations in total. Clearly mention updated centroid after each iteration.

Question # 05: - **(5 marks)**

Consider the dataset shown below. Find clusters using single link technique. Use Euclidean distance and draw the dendrogram.

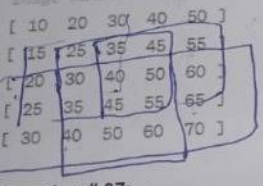
	X	Y
P1	0.40	0.53
P2	0.22	0.38
P3	0.35	0.32
P4	0.26	0.19
P5	0.08	0.41
P6	0.45	0.30

CLO -4

Apply reinforcement and deep algorithms to environments with complex dynamics.

Question # 06: - **(10 marks)**

Consider the following grayscale image: Apply a 3x3 edge detection filter and generate the feature map.



Filter:

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[ -1  -1  -1 ]
[ -1   8  -1 ]
[ -1  -1  -1 ]
```

Question # 07: - **(5 marks)**

Explain the concept of convolutional neural networks (CNNs) and their applications in computer vision tasks. Describe the role of convolutional layers, pooling layers, and fully connected layers in CNNs.

Question # 08: - **(5 marks)**

What is the role of reward functions in reinforcement learning? How are they defined and used to guide the learning process?

Best of Luck