Bahria University, Islamabad Campus
Department of Computer Science
Final Term Examination
Class & Section: BS(CS)-6A,6B Morning
(Spring 2023 Semester)
Paper Type: Descriptive

Course:	**Artificial Intelligence**	Date: 08/07/2023
Course Code:	CSC-325	Session: I
Faculty's Name:	Dr. Hafiz Ishfaq & Mr. Usama Imtiaz	Max Marks: 50
Time Allowed:	2.5 Hours	Total Pages: 10

INSTRUCTIONS:

1. This is closed book exam. Communication devices and any written material is strictly prohibited.
2. All questions are compulsory.
3. Calculator sharing is strictly prohibited.
4. Use permanent ink pens only. Any part done using soft pencil will not be marked and cannot be claimed for rechecking.
5. Return the question paper along with the answer sheet -5 Marks for not returning the question paper.
6. Solve all the question in sequence on answer sheet as given in the question paper.
7. After the calculations create a table to fill in the desired values as instructed in the question paper.

Student's Name: _____ Enroll No:_____

(USE CAPITAL LETTERS)

Question # 1 (4+2+4 Marks) ……..……..……..……..…..…..…..**(CLO-3)**

Assume we have the following function

f(x) = x3 - 60 * x2 + 900 * x +100

where x is constrained to 0..31. We wish to maximize f(x) (the optimal is x=10) Using a binary representation we can represent x using five binary digits

1. Given the following four chromosomes give the values for x and f(x).

Chromosome	Binary String	x	f(x)
P1	11100		
P2	01111		
P3	10111		
P4	00100		

2. If P3 and P2 are chosen as parents and we apply crossover, show the resulting children, C1 and C2. Do the same using P4 and P2 with a crossover on different place and create C3 and C4.

3. Calculate the value of x and f(x) for C1 to C4

Chromosome	Binary String	x	f(x)
C1			
C2			
C3			
C4			

Question # 2 (5 Marks)……..……..……..……..…..…..……**(CLO-2)**

Apply naïve bayes algorithm to predict the class of the given test data
The test data is
Green Large Rectangle Yes (Class= ?)

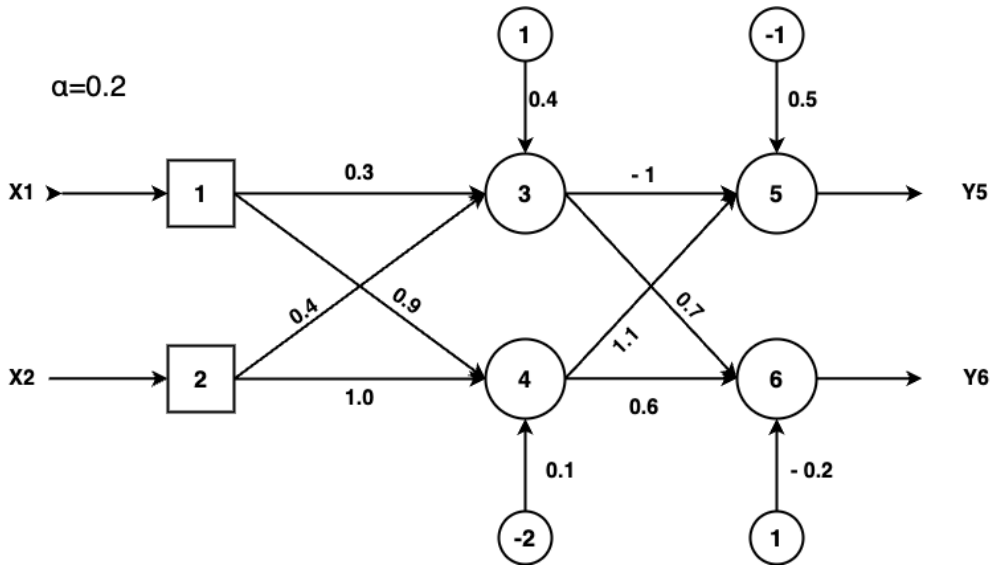
- Calculations are a must. Any solution without calculation will not be graded.

Feature1	Feature2	Feature3	Feature4	Class
Red	Small	Square	Yes	A
Blue	Large	Rectangle	No	B
Green	Medium	Circle	Yes	A
Green	Small	Triangle	No	C
Red	Large	Square	Yes	B
Blue	Small	Rectangle	No	A
Green	Medium	Circle	Yes	A
Red	Small	Triangle	No	C
Blue	Medium	Square	Yes	B

Question # 3 (14 Marks) …….…… …… …… ……..…… ……..…… **(CLO-4)**

Consider the neural network below. Perform one forward pass and fix the error and update the weight for the given inputs and outputs. You need to be accurate in your calculations. Please perform calculations up to 4 decimal places. This shows the complete working of the algorithm; fill in the table on the right, no marks will be awarded without that. Direct answers will not get any marks.

Inputs: X1 = 2, X2 = 3,
Output: Y5 = 1, Y6 = 0,
w1 = 0.3, w2 = 0.4, w3 = 0.9, w4 = 1.0, w5 = -1, w6 = 1.1, w7 = 0.7 and w8 = 0.6
Alpha = 0.2
Activation function in the neurons is sigmoid function.



	Va
Y3	
Y4	
Y5	
Y6	
E5	
E6	
ΔW	
ΔW5	
ΔW6	
ΔW7	
ΔW8	

Question # 4 (5 Marks) **.....(CLO-3)**

Suppose you are given the following data pairs. You will simulate the k-means algorithm to identify TWO clusters in the data.

Data #	x	y
1	1.90	0.97
2	1.76	0.84
3	2.32	1.63
4	2.31	2.09
5	1.14	2.11
6	5.02	3.02

Data#	Cluster Assignment after 1st Iteration	Cluster Assignment after 2nd Iteration
1		
2		
3		
4		
5		
6		

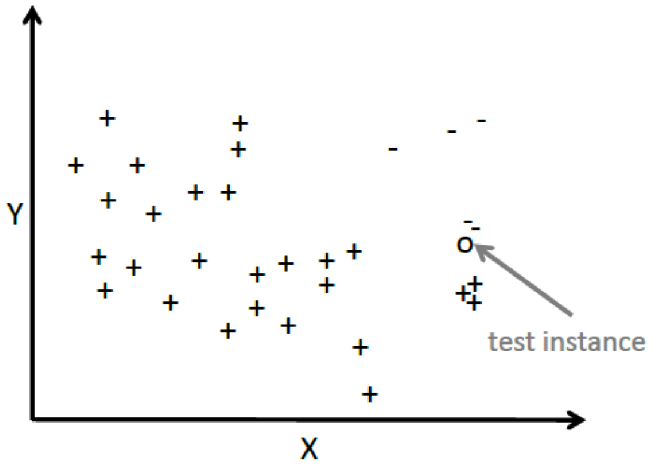
Suppose you are given initial assignment cluster center as {cluster1: #1}, {cluster2: #6} – the first data point is used as the first cluster center and the 10-th as the second cluster center.

Please simulate the k-means (k=2) algorithm for TWO iteration. What are cluster assignments after TWO iteration? (Fill in the table below)

Assume k-means uses Euclidean distance. Calculate distance value up to 4 decimal places. In case of tie, you can assign the data point to cluster #1.

Question # 5 (2+2+2+2 Marks) ……(CLO-3)

A KNN classifier assigns a test instance the majority class associated with its K nearest training instances. Distance between instances is measured using Euclidean distance. Suppose we have the following training set of positive (+) and negative (-) instances and a single test instance (o). All instances are projected onto a vector space of two real-valued features (X and Y). Answer the following questions. Assume "unweighted" KNN (every nearest neighbor contributes equally to the final vote).



(a) How is training performed in KNN?
(b) What would be the class assigned to this test instance for K=1
(c) What would be the class assigned to this test instance for K=5
(d) Setting K to a large value seems like a good idea. We get more votes! Given this particular training set, would you recommend setting K = 11? Why or why not?

Question # 6 (2+2+2+2 Marks) ……(CLO-1)

(a) The Back-Propagation learning algorithm for training feed-forward neural networks requires the activation and error functions to be differentiable. Explain what that means and why it is true ?
(b) Describe what is likely to happen when a learning rate is used that is too large, and when one is used that is too small. How can one optimize the learning rate?
(c) Explain the main reasons why a Back-Propagation training algorithm might not find a set of weights which minimizes the training error for a given feed-forward neural network ?
(d) What are local minima, and why are they a problem? How might one improve the chances of finding the global minimum?

Best of Luck