Artificial Intelligence Lab

Final Exam

Date: Dec 24th, 2024

Course Instructor(s)

Usman Anwer

Rida Mehmood

Total Time (Hrs): 2.30

Total Marks: 70

Total Questions: 2

Roll No

3CS-7A

Section

Student Signature

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Attempt all the questions.

Important Instructions:

a) Write your code in jupyter. Internet will be turned off.

b) Understanding the problem statements is also part of the exam. Make assumptions wherever required.

c) Submission path is
\\Cactus1\Xeon\Fall 2024\Usman Anwer\AI Lab Exam\BCS-7A1\Submissions
\\Cactus1\Xeon\Fall 2024\Usman Anwer\AI Lab Exam\BCS-7B1\Submissions
submit your exam in respective section only.

d) Copy and edit BSCS_AI_Lab_Exam_6A_Fall_24.ipynb file from above path. Use this file to write your code in the specified areas. Create user defined functions(if required).

e) Use your Student Id to save the file. Submissions without student ids will be marked against zero.

f) Any type of plagiarism/copy will lead to DC.

CLO 1: Apply genetic algorithms to solve optimization problems by designing and implementing suitable algorithmic solutions, and critically analyze the performance of the developed algorithms using appropriate evaluation metrics.

Question 1: [marks=40]

Write a Genetic Algorithm (GA) to solve the following problem:
You are given a city represented as a graph, G = (V, E), where:

- V is the set of vertices representing locations (e.g., streets, intersections, and ATMs).
- E is the set of edges representing the roads between these locations. Each edge has an associated distance (or cost).

The task is to find the shortest path between a given source location A and a destination location

F, ensuring that the path passes through at least three ATMs (vertices marked as ATMs in the graph). Your program has to prescribe a shortest path which contains at-least 3 ATMs.

Set of vertices are:

V = {A, B, C, D, E, F}

E = {
(A, B, 4), (A, C, 2), (B, C, 5),
(B, D, 10), (C, E, 3), (E, D, 4),
(E, F, 2), (D, F, 6)
}

ATMs: {C, E, F}
Source: A
Destination: F

CLO 2: Apply the principles of unsupervised learning to implement K-Means clustering for data segmentation, and analyze the performance of clustering results using appropriate evaluation metrics.

Question 2: [marks=30]

Consider a dataset containing data points from a 2-dimensional space as shown below:

X1	X2
1.0	2.0
1.5	1.8
5.0	8.0
8.0	8.0
1.0	0.6
9.0	11.0

8.0	5.0

Task:

1. Implement the K-means algorithm from scratch to cluster this dataset into 3 clusters.
   - Initialize the centroids randomly (choose 3 points from the dataset as initial centroids).
   - Assign each customer to the nearest centroid using Mentioned distance.
   - Recompute the centroids based on the mean of the assigned customers.
   - Repeat until convergence (when centroids do not change or a set number of iterations is reached).
   - Visualize the final clusters for each of the distance metrics.
2. For the assignment of points to clusters, compute the distance between the data points and the centroids using the following distance metric:

   - **Cosine Similarity:** $D = \frac{1 - \text{cosine similarity}}{2}$

   Note: Cosine similarity is defined as:

$$\text{cosine similarity} = \frac{x_1 \cdot x_2}{\|x_1\| \|x_2\|}$$

   where $\|x\|$ is the Euclidean norm of vector x.