Air University Islamabad (Department of computer Science)

Artificial Intelligence – 7B

Assignment NO. 2

Semester: Fall 2025	**Max Marks:** 10
Instructor: Sara Ibrahim	
Assigned Date: 30th Oct, 2025	**Due Date:** 2nd Nov, 2025
Name:	**Reg. No.**

CLO 2: Implement Classical Artificial Intelligence Techniques (C3 - Implement)

Objective:

The goal of this assignment is to implement classical artificial intelligence techniques such as Informed Search Algorithms, including Greedy Search, A* Search, and Local Search techniques. Students are required to apply these algorithms to given problem scenarios and demonstrate their effectiveness using numerical computations and comparisons.

Question 1: Path Cost Calculation using A Search

Problem Statement:

Consider the following path costs from **Arad to Bucharest** using A* Search:

City	g(n) (Path Cost)	h(n) (Heuristic)	f(n) = g(n) + h(n)
Arad	0	366	366
Sibiu	140	253	393
Rimnicu	220	193	413
Pitesti	317	98	415
Bucharest	418	0	418

Tasks:

1. Compute the step-by-step expansion of nodes in A* Search.
2. Compare the computed results with Greedy Search.

Question 2: 8-Puzzle Problem using Hill Climbing

Problem Statement:

Consider the following **initial state** of an 8-puzzle problem:

2	**8**	**3**
1	6	4
7	0	5

Goal state:

1	**2**	**3**
8	0	4
7	6	5

Tasks:

1. Use **Manhattan Distance** to compute the heuristic value at each step.
2. Demonstrate how Hill Climbing finds an optimal or suboptimal solution.

***Question 3: A Search Algorithm for Delivery Routes* Problem Statement:**
A company wants to optimize its **delivery routes** to minimize the cost and time taken for deliveries.

The following graph represents the city's intersections and roads with travel costs:

Location	Connected Locations (Cost)
Warehouse (W)	A (4), B (3)
A	C (2), D (5)
B	D (2), E (4)
C	F (3)
D	F (2), G (5)
E	G (3)
F	H (2)
G	H (4)

Heuristic Values (h):

Location	Heuristic (h)
W	8
A	6
B	7
C	4
D	3
E	5
F	2
G	2
H	0

Tasks:

1. Implement the *A Search Algorithm** to find the optimal path from **W to H**.
2. Show step-by-step calculations for node expansion, f(n) = g(n) + h(n).
3. Compare A* results with Greedy Search in terms of computational efficiency and path cost.

Question 4: Local Search - Hill Climbing for Exam Seating Problem Statement:
A university is organizing seating arrangements for a final examination. The objective is to minimize cheating by ensuring students from the same department are seated apart. Each student is assigned a seat based on an 8x8 grid, and the heuristic function calculates conflicts.

Tasks:

1. Implement Hill Climbing to arrange students with minimal conflicts.
2. Use a heuristic function that counts the number of conflicts (same department neighbors).
3. Show the seating arrangement at different steps.
4. Discuss the limitations of Hill Climbing, such as local maxima, plateaus, and ridges.

Important Information:

Heuristic = number of **conflicts**, where a conflict means:

A student has a neighbor from the same department.

Lower heuristic → better arrangement.

Goal: minimize heuristic to **0 (no conflicts)** or as low as possible.

Submission Guidelines:

- Submit a detailed report with implementations, tables, numerical calculations, and explanations.
- The deadline for submission is **2/11/2025.**
- Late submissions will result in a deduction of marks.

Good Luck 😊