National University of Computer & Emerging Sciences

AL2002 – Artificial Intelligence – Lab (Spring 2025)

BSCS-6B

Lab Work 4 (Informed Searches – Best First Search, A* Search)

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Instructions:

1. You also have to submit word file.
2. Comments in the code explaining chunks of the code are important.
3. Plagiarism is strictly prohibited, 0 marks would be given to students who cheat.

Lab Tasks:

Task 1:

A city wants to implement a **Smart Navigation System** for emergency vehicles (ambulances, fire trucks, and police cars). The goal is to find the fastest possible route from a given **source (hospital, fire station, or police station)** to a **destination (accident site, fire location, or crime scene)** based on estimated travel times rather than just distances.

Graph Representation
The city road network is represented as a **graph**, where:

- **Intersections** are represented as **nodes (vertices).**
- **Roads between intersections** are represented as **edges with weights**, where the weight represents the **estimated time to travel the road (not just distance but also factors like traffic and road conditions).**

Applying Best First Search (BFS)
The **Best First Search (BFS)** algorithm can be used to guide the emergency vehicle to the destination **as quickly as possible** by always selecting the next intersection that seems to have the **lowest estimated time (heuristic)**.
Example Execution

1. An ambulance starts from a hospital at **Node A** and needs to reach an accident at **Node G**.
2. The system uses **traffic data, road conditions, and estimated speeds** to assign weights (estimated time) to the edges.
3. BFS prioritizes the **next node with the lowest heuristic (estimated remaining time)** to reach the destination.
4. The algorithm finds the best path that minimizes the **total travel time**, not just the shortest distance.

Use **geographical coordinates (latitude, longitude)** for intersections, use the **Euclidean distance** for heuristic calculation.
Calculate time complexity and space complexity and final path.

Task 2:

NASA has deployed a **Mars Rover** to explore an unknown terrain. The rover must navigate from its **current position (start node)** to a **target location (goal node)** while avoiding obstacles like **craters, rocks, and steep slopes**. The goal is to find the **shortest and safest path** using the *A (A-*

star) Search Algorithm.*

Graph Representation

The Mars terrain is represented as a **grid-based graph**, where:

- Each **grid cell** represents a **node (vertex)**.
- The **edges** represent **possible movements** (e.g., up, down, left, right, diagonal).
- Each edge has a **weight (cost)**.

Applying A Search*

A* Search finds the **most optimal path**.

Calculate the Heuristic value using Manhattan Distance .

Example Execution

1. The rover starts at **(0,0)** and must reach **(5,5)**.
2. A* prioritizes paths that **minimize both actual cost and estimated cost**.

Calculate time complexity and space complexity and final path.