Assignment 1

Optimal Delivery Route for a Drone

A delivery company operates drones to transport packages across a city. The city is represented as a grid of size **N x N**, where each cell indicates the cost of traveling through it. The drone begins at a specific starting cell (**Sx, Sy**) and must deliver the package to the destination cell (**Dx, Dy**). Your task is to implement the **A*** search algorithm to determine the least-cost path from the starting cell to the destination.
You can find the template here: A_star template

Requirements:

- **Input Representation:**
  - The city grid is represented as a 2D matrix `Grid[N][N]`, where each element is a **non-negative integer** indicating the **travel cost for that cell.**
  - Cells marked with a travel cost of `-1` represent **obstacles**, and the drone cannot pass through these cells.
- **Drone Movement:**
  - The drone can move in **four cardinal directions** (up, down, left, right) and diagonally.
  - The cost of moving to a neighboring cell is equal to the travel cost of that cell as given in the grid.
- **Heuristic Function:**
  - Use the **Euclidean distance** as the heuristic function to estimate the cost from the current cell (**x, y**) to the destination cell (**Dx, Dy**):

$$h(x, y) = \sqrt{(x - Dx)^2 + (y - Dy)^2}$$

- **Objective:**
  - Implement the **A*** search algorithm to find the least-cost path from the start cell to the destination cell.
  - Return:
    1. The **total cost** of the optimal path.
    2. The **sequence of cells** that form the optimal path.

Sample Input	Sample Output
Grid = [[1, 1, 1, -1], [1, -1, 1, 1], [1, 1, 1, 1], [1, -1, 1, 1]] Sx, Sy = (0, 0) Dx, Dy = (3, 3)	**Optimal Cost:** 5 **Optimal Path:** (0,0)→(0,1)→(1,2)→(2,3)→(3,3)
Grid = [[2, 3, 1, -1], [1, -1, 4, 2], [1, 2, 3, 1], [3, -1, 2, 1]] Sx, Sy = (0, 0) Dx, Dy = (3, 3)	**Optimal Cost:** 8 **Optimal Path:** (0,0)→(1,0)→(2,1)→(3,2)→(3,3)

Submission Guidelines:

- Submit only the .ipynb or .py file
- Rename the file with your Student ID
- **Late submission will result in marks deduction.**
- **You can take help from the internet, but make sure to understand the code fully so that you can explain it during the viva. Failure to do so will result in the reduction of marks.**
- **Marks Distribution:**
  - **Input + Output(as shown in the sample): 5**
  - **Implementing the heuristic: 7**
  - **Viva: 8**
- **Deadline: 27 November 2024 11:00 am**