**10. Write the python program to implement A\* algorithm**

**Program:**

import heap

class Node:

def \_\_init\_\_(self, position, parent=None):

self.position = position # (x, y)

self.parent = parent

self.g = 0 # Distance from start node

self.h = 0 # Heuristic to goal

self.f = 0 # Total cost

def \_\_lt\_\_(self, other):

return self.f < other.f

def heuristic(a, b):

# Manhattan distance

return abs(a[0] - b[0]) + abs(a[1] - b[1])

def astar(grid, start, goal):

open\_list = []

closed\_set = set()

start\_node = Node(start)

goal\_node = Node(goal)

heapq.heappush(open\_list, start\_node)

while open\_list:

current\_node = heapq.heappop(open\_list)

closed\_set.add(current\_node.position)

# Goal check

if current\_node.position == goal\_node.position:

path = []

while current\_node:

path.append(current\_node.position)

current\_node = current\_node.parent

return path[::-1] # Reversed path

# Explore neighbors (up, down, left, right)

(x, y) = current\_node.position

neighbors = [(x-1, y), (x+1, y), (x, y-1), (x, y+1)]

for next\_pos in neighbors:

(nx, ny) = next\_pos

if 0 <= nx < len(grid) and 0 <= ny < len(grid[0]) and grid[nx][ny] == 0:

if next\_pos in closed\_set:

continue

neighbor = Node(next\_pos, current\_node)

neighbor.g = current\_node.g + 1

neighbor.h = heuristic(next\_pos, goal\_node.position)

neighbor.f = neighbor.g + neighbor.h

# Avoid duplicates with higher cost

if any(open\_node.position == neighbor.position and open\_node.f <= neighbor.f for open\_node in open\_list):

continue

heapq.heappush(open\_list, neighbor)

return None # No path found

# Example grid: 0 = free space, 1 = obstacle

grid = [

[0, 0, 0, 0, 0],

[0, 1, 1, 1, 0],

[0, 0, 0, 1, 0],

[1, 1, 0, 0, 0],

]

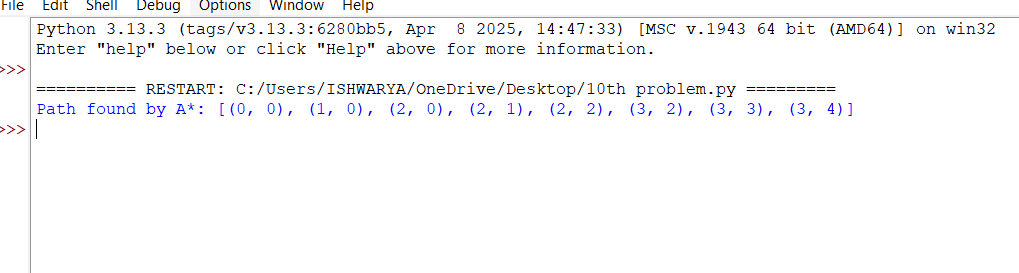
start = (0, 0)

goal = (3, 4)

path = astar(grid, start, goal)

print("Path found by A\*:", path)

**output:**

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