PRINCIPLES OF ARTIFICIAL INTELLIGENCE LAB – EXPERIMENT 4:A*SEARCH

```
import heapq


# Define the grid and movements
class Node:
    def __init__(self, position, parent=None, g=0, h=0):
        self.position = position  # (row, col)
        self.parent = parent  # Parent node
        self.g = g  # Cost from start node
        self.h = h  # Heuristic cost to goal
        self.f = g + h  # Total cost

    def __lt__(self, other):
        return self.f < other.f  # Priority queue comparison

def heuristic(a, b):
    return abs(a[0] - b[0]) + abs(a[1] - b[1])  # Manhattan Distance

def a_star(grid, start, goal):
    rows, cols = len(grid), len(grid[0])
    open_list = []
    heapq.heappush(open_list, Node(start, None, 0, heuristic(start, goal)))
    closed_set = set()
```

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    while open_list:
        current_node = heapq.heappop(open_list)  # Get node with lowest f-value

        if current_node.position == goal:
            path = []
            while current_node:
                path.append(current_node.position)
                current_node = current_node.parent
            return path[::-1]  # Return reversed path

        closed_set.add(current_node.position)

        for dr, dc in [(-1, 0), (1, 0), (0, -1), (0, 1)]:  # Possible moves
            new_pos = (current_node.position[0] + dr, current_node.position[1] + dc)

            if (0 <= new_pos[0] < rows and 0 <= new_pos[1] < cols and
                grid[new_pos[0]][new_pos[1]] == 0 and new_pos not in closed_set):

                new_node = Node(new_pos, current_node, current_node.g + 1, heuristic(new_pos,
goal))
                heapq.heappush(open_list,  new_node)

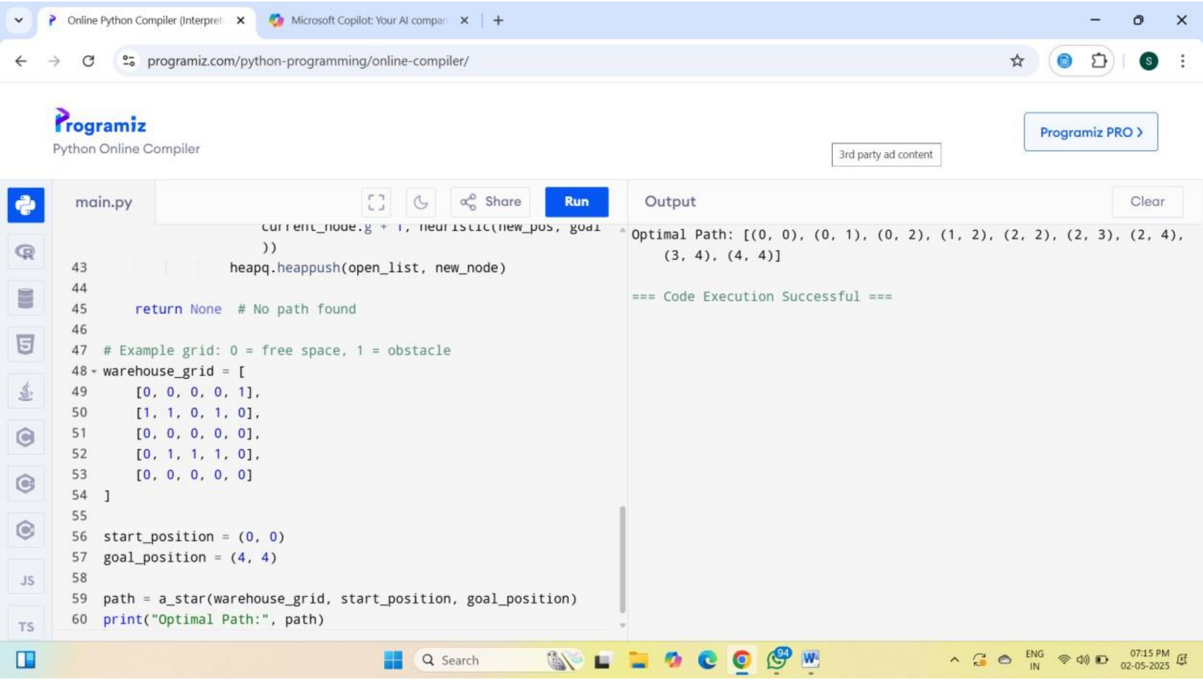
    return None  # No path found

# Example grid: 0 = free space, 1 = obstacle
warehouse_grid = [
```

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

start_position = (0, 0)
goal_position = (4, 4)

path = a_star(warehouse_grid, start_position, goal_position)
print("Optimal Path:", path)
```



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