Fr. Conceicao Rodrigues College of Engineering Fr. Agnel Ashram, Bandstand, Bandra (W), Mumbai - 400050

Department of Computer Engineering

Academic Term II: 23-24

Class: B.E (Computer), Sem – VI Subject Name: Artificial Intelligence Student

Name: Sumit Sanjay Rai **Roll No: 9570**

Practical No:	**5**
Title:	Eight puzzle game solution by A* algorithm
Date of Performance:	**04/03/2024**
Date of Submission:	**11/03/2024**

Rubrics for Evaluation:

Sr. No	**Performance Indicator**	**Excellent**	**Good**	**Below Average**	**Marks**
1	On time Completion & Submission (01)	01 (On Time)	NA	00 (Not on Time)	
2	Logic/Algorithm Complexity analysis (03)	03(Correct)	02(Partial)	01 (Tried)	
3	Coding Standards (03): Comments/indention/Naming conventions Test Cases /Output	03(All used)	02 (Partial)	01 (rarely followed)	
4	Post Lab Assignment (03)	03(done well)	2 (Partially Correct)	1(submitted)	
Total					

Signature of the Teacher:

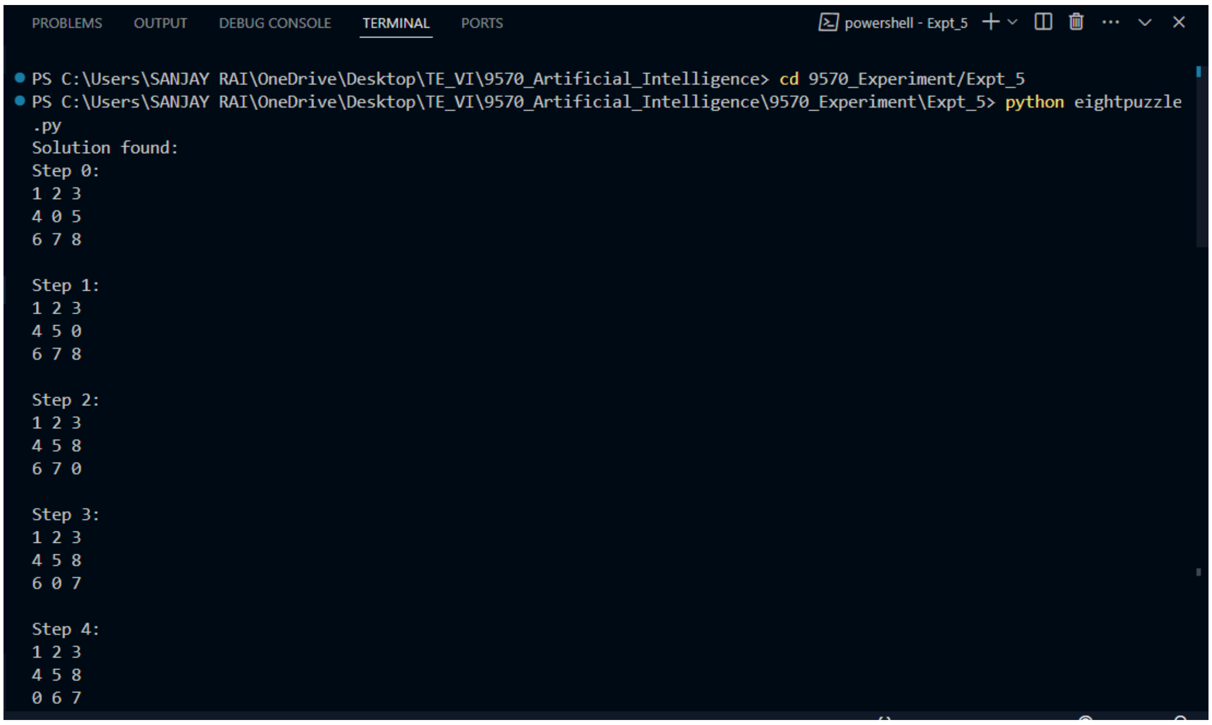
Source code:

```
from heapq import heappush, heappop

# Define the goal state for the 8 puzzle problem
GOAL_STATE = (1, 2, 3, 4, 5, 6, 7, 8, 0)  # 0 represents the empty space


class PuzzleState:
    def __init__(self, board, parent=None, cost=0):
        self.board = tuple(board)
        self.parent = parent
        self.cost = cost

    def __lt__(self, other):
        return (self.cost + self.heuristic()) < (other.cost + other.heuristic())

    def __eq__(self, other):
        return self.board == other.board

    def __hash__(self):
        return hash(self.board)

    def heuristic(self):
        # Manhattan distance heuristic
        distance = 0
        for i in range(3):
            for j in range(3):
                if self.board[i * 3 + j] != 0:
                    value = self.board[i * 3 + j] - 1
                    distance += abs(i - (value // 3)) + abs(j - (value % 3))
        return distance

    def is_goal(self):
        return self.board == GOAL_STATE

    def successors(self):
        successors = []
        zero_index = self.board.index(0)
        row, col = zero_index // 3, zero_index % 3

        for dr, dc in [(1, 0), (-1, 0), (0, 1), (0, -1)]:
            new_row, new_col = row + dr, col + dc
            if 0 <= new_row < 3 and 0 <= new_col < 3:
                new_board = list(self.board)
                new_board[row * 3 + col], new_board[new_row * 3 + new_col] = new_board[new_row
* 3 + new_col], 0
                successors.append(PuzzleState(new_board, parent=self, cost=self.cost + 1))

        return successors
```

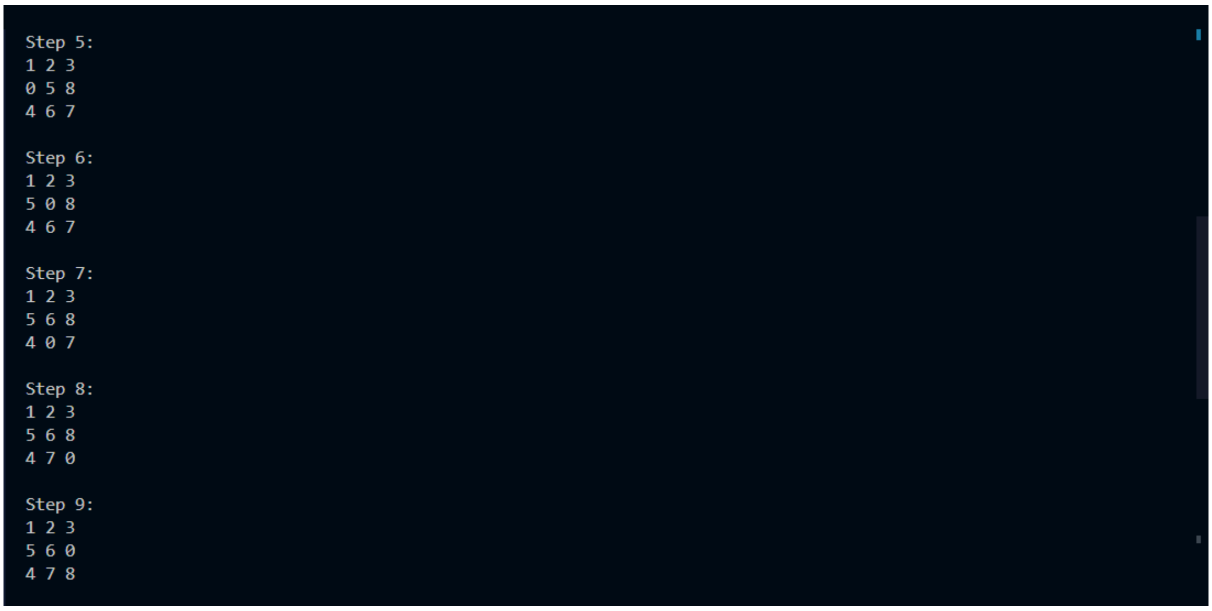
```
def a_star_search(initial_state):
    frontier = []
    explored = set()

    heappush(frontier, initial_state)

    while frontier:
        current_state = heappop(frontier)

        if current_state.is_goal():
            return current_state

        explored.add(current_state)

        for neighbor in current_state.successors():
            if neighbor not in frontier and neighbor not in explored:
                heappush(frontier, neighbor)
            elif neighbor in frontier:
                existing_neighbor = frontier[frontier.index(neighbor)]
                if neighbor.cost < existing_neighbor.cost:
                    frontier.remove(existing_neighbor)
                    heappush(frontier, neighbor)

    return None  # No solution found


def print_solution(solution_state):
    path = []
    current_state = solution_state
    while current_state:
        path.append(current_state.board)
        current_state = current_state.parent
    path.reverse()

    for i, state in enumerate(path):
        print(f"Step {i}:")
        print_board(state)
        print()


def print_board(board):
    for i in range(3):
        print(" ".join(str(board[i * 3 + j]) for j in range(3)))


def main():
    # Example initial state
    initial_state = PuzzleState([1, 2, 3, 4, 0, 5, 6, 7, 8])

    solution_state = a_star_search(initial_state)
```

```python
    if solution_state:
        print("Solution found:")
        print_solution(solution_state)
    else:
        print("No solution found.")


if __name__ == "__main__":
    main()
```

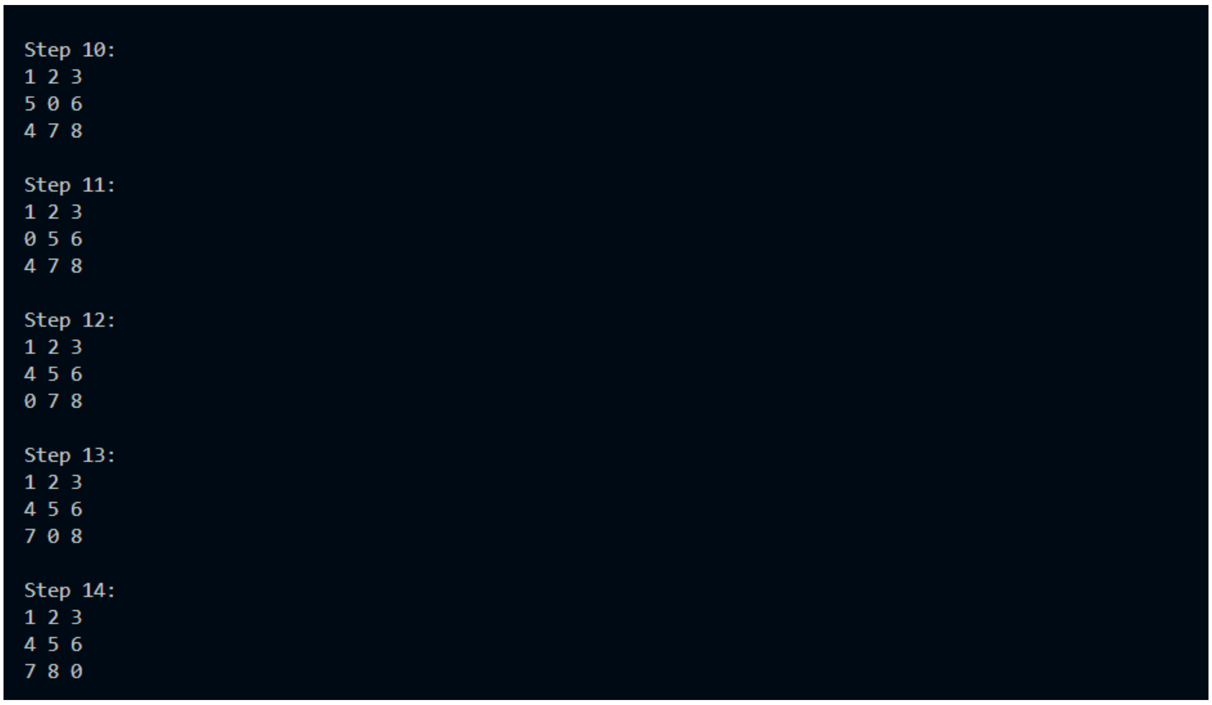
Output:



```
PS C:\Users\SANJAY RAI\OneDrive\Desktop\TE_VI\9570_Artificial_Intelligence> cd 9570_Experiment/Expt_5
PS C:\Users\SANJAY RAI\OneDrive\Desktop\TE_VI\9570_Artificial_Intelligence\9570_Experiment\Expt_5> python eightpuzzle
.py
Solution found:
Step 0:
1 2 3
4 0 5
6 7 8

Step 1:
1 2 3
4 5 0
6 7 8

Step 2:
1 2 3
4 5 8
6 7 0

Step 3:
1 2 3
4 5 8
6 0 7

Step 4:
1 2 3
4 5 8
0 6 7
```



```
Step 5:
1 2 3
0 5 8
4 6 7

Step 6:
1 2 3
5 0 8
4 6 7

Step 7:
1 2 3
5 6 8
4 0 7

Step 8:
1 2 3
5 6 8
4 7 0

Step 9:
1 2 3
5 6 0
4 7 8
```



```
Step 10:
1 2 3
5 0 6
4 7 8

Step 11:
1 2 3
0 5 6
4 7 8

Step 12:
1 2 3
4 5 6
0 7 8

Step 13:
1 2 3
4 5 6
7 0 8

Step 14:
1 2 3
4 5 6
7 8 0
```